ELECTRICAL CONSTRUCTION AND MAINTENANCE

With which is consolidated Electrical Contracting, The Electragist and Electrical Record...Established 1901

A practical technical and management journal for electrical contractors industrial electricians, inspectors, engineers and motor shops, [illegible] in the field of electrical construction and maintenance.

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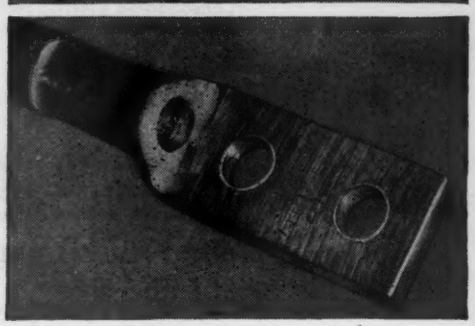

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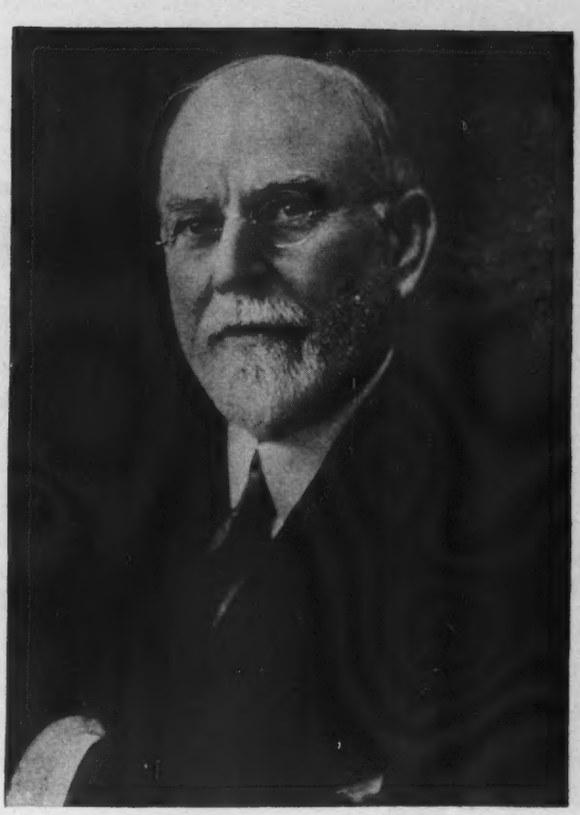
JAMES H. McGRAW

1860—1948



From subscription salesman to founder of the world's largest industrial publishing organization, the career of James H. McGraw, who died February 21, at the age of 87, was one of the most colorful in publishing history. Standards of publishing which he fostered have given the business and industrial press of this country stature and authority unrivaled over the world. He laid the foundation for the McGraw-Hill Publishing Company, publishers of 26 national magazines, of which *Electrical Construction and Maintenance* is one, and eight international magazines, and, through its subsidiary, the McGraw-Hill Book Company, largest publishing house specializing in technical and industrial books.

He resigned on Dec. 27, 1935, as chairman of the Board of Directors, when his responsibilities were taken over by his son, James H. McGraw, Jr., who assumed the presidency and chairmanship of the Board. He maintained always an alert interest in the company and in the work of the world.

It has been said by his associates that Mr. McGraw always had a "remarkably high standard of dissatisfaction." He pressed continually for improvement in editorial competence and authority, in advertising ethics and proficiency. He was also a builder of men. He insisted upon editorial leadership based on constant field contact and active participation by editors in the activities of their industries. He maintained that a good editor wore out his shoes rather than the seat of his trousers, and he had no patience with the old notion of editorial isolation. He was no less insistent upon truth in advertising and the responsibility of the business press for the efficient development of markets.

Mr. McGraw based the expansion of his publishing activities on the five major engineering professions and industries allied with them. Throughout his long career, he was a pioneer.

More fortunate than many leaders, Mr. McGraw lived to receive the acclaim of men in all civilized countries for his leadership of a business press whose great achievement is teaching men everywhre how to do their jobs better.

At one point in his career Mr. McGraw foresaw the doom of the horse-car and his first official act as an independent publisher was to hire an electrical editor for his "Street Railway Journal." Almost immediately, developments in that industry proved he was right. By 1901, he had acquired "Electrical World" and "Electrical Engineer," later consolidated as "Electrical World." He later added "Engineering Record," "Chemical and Metallurgical Engineering," and "Electrical Merchandising." Still later were to come "Electrical Construction and Maintenance," "Electrical Wholesaling," and "Electrical West," in the electrical field.

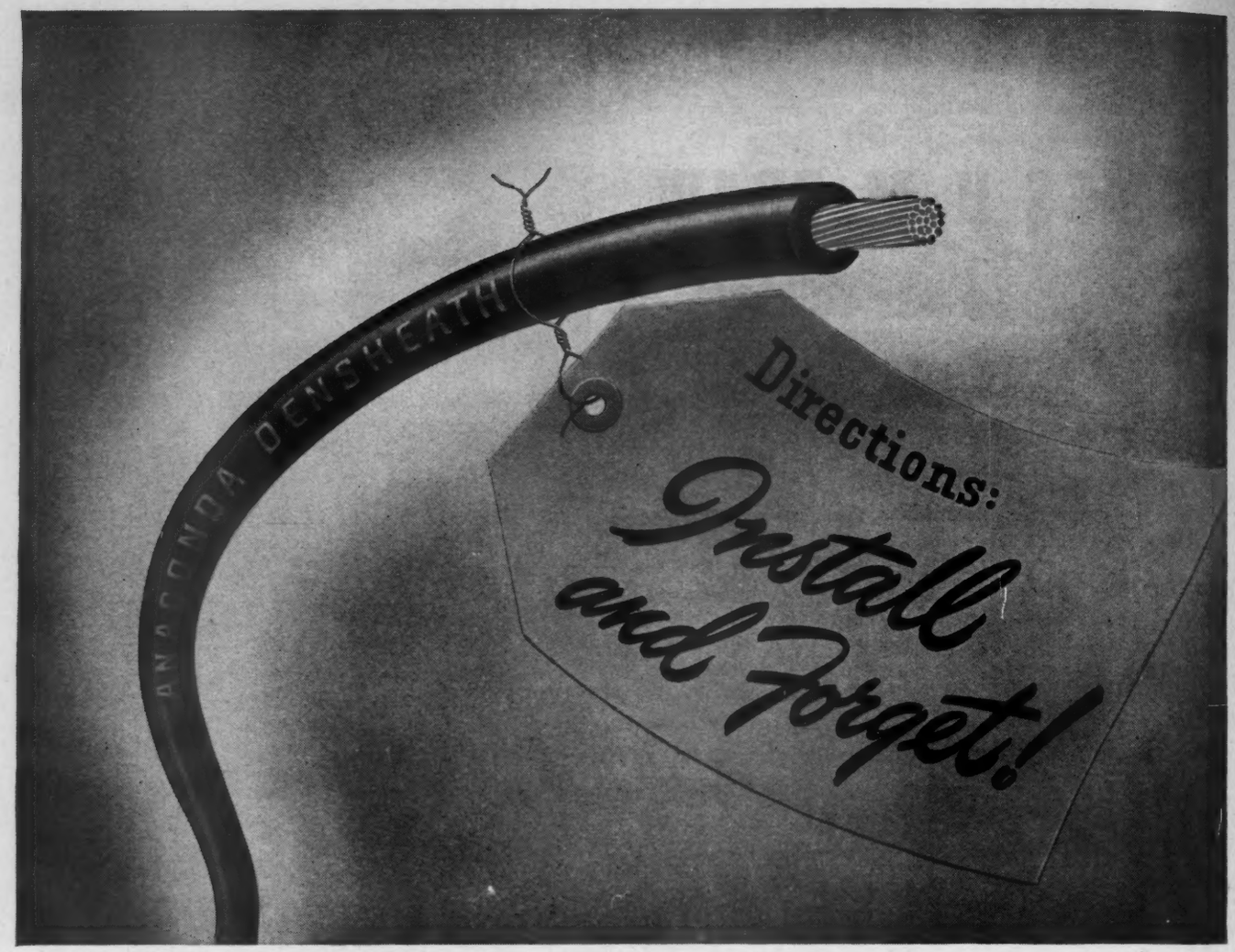
Upon the death, in 1916, of John A. Hill, who had left an engine throttle in the Far West to come East and work on a locomotive paper, the McGraw Publishing Company acquired the Hill publications, thereby adding "American Machinist," "Power," "Coal Age," "Engineering News," and "Engineering and Mining Journal" to the group. "Engineering Record" and "Engineering News," were combined, and the McGraw-Hill organization began with nine publications.

In 1909, seven years before the parent companies were consolidated, the book departments of the McGraw and Hill companies were merged as a separate company, known then, as now, as the McGraw-Hill Book Company. With a list of some 2400 active titles, it has expanded its field to cover practically all branches of pure and applied science, including economics, business, and the social sciences, and has played an important role in two World Wars, providing textbooks for service men and for the industries serving them. A trade division, Whittlesey House, was established in 1930, and still a further venture,—publication of fiction, began in 1944.

In 1929, Mr. McGraw received the degree of Doctor of Commercial Science from New York University, conferred on him as "an educator transformed into publisher, who has never ceased to be an educator." In 1944, he was honored by the Fredonia State Teachers' College Alumni Association by being named, with Edgar C. Markham, for the "Distinguished Service Certificate" given annually to two alumni of outstanding contribution.

The Bok gold medal, presented annually as the Harvard Advertising Award, "for distinguished personal service rendered American commerce and industry through raising the standards of advertising," went to Mr. McGraw in 1927.

In 1925 the publisher established the James H. McGraw Award "to encourage constructive thinking for the advancement of the electrical industry." An endowed award, of four medals and a purse, is given in recognition of the most important personal contributions to electrical progress in the manufacturing, wholesaling and contracting branches, and for cooperation in promoting the general welfare of the industry.



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HEATING OUTLOOK

ELECTRIC HEATING is beginning a great new phase of electrical development. The trends and the speed with which these trends are developing are too clear to ignore. Electric heating is persistently taking over tasks that previously required some form of combustion.

ELECTRIC RANGES, electric water heaters, industrial infrared drying and baking, commercial food preparation are all examples of areas in which long established equipments and methods are rapidly giving way to electricity. And here and there, in Tennessee or Washington or California, we find a house, a factory or a big department store with electric space heating.

SALES OF INBUILT bathroom heaters are up. A large manufacturer is establishing trade channels for distributing electric ceiling panels for home heating. Reverse cycle refrigeration which picks up stored heat in earth or air or water offers summer cooling and winter heating with kilowatt hours. Heating engineers with data tables and slide rules are developing astounding figures to show how expensive electric space heating can be, compared to fuels. But their audience seems to be paying little heed.

IN THE ELECTRICAL INDUSTRY we are not without some engineering viewpoint ourselves. We can understand application of electric heat to industrial processes where production techniques far outweigh fuel costs. In fact, we are pretty aggressive about it. We can understand some commercial and residential applications of electric heat. We can recognize advantages and conveniences particularly in areas where rates are very low. But the engineering mind stands baffled in the presence of a public demand for electric space heating which may cost two or three times as much a year as other conventional methods.

WHY NOT FACE IT? Maybe electric space heat is a luxury. So's your wife's new spring hat and all that shiny chrome on your new car. The people of this country have a notorious history of ignoring the engineer's vigorous concept of economy. Once electric heat strikes the public imagination, no B.t.u. vs. kwh. comparison will long delay it.

TODAY WE CAN SEE only the distant outlines of an enormous potential market. The immediate foreground is cluttered with irksome realities. Present wiring systems certainly cannot tolerate added kilowatts. Generating capacity and distribution is making slow headway trying to forge ahead of already existing demand. But neither long range utility planning nor present wiring practices seem to include the capacity requirements that would be necessary for more than a modest increase in auxiliary heating. Why? Don't we believe in the future of our industry?

THE RATE OF GROWTH of electric heating may be slowed by its luxury status. But luxuries can become necessities in our economy with awful suddenness. We may have a bear by the tail.

Wm. F. Stuart

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For many applications in small plants, offices, stores — where customers want to keep equipment and maintenance at minimum — Graybar suggests U.S.I. Sound Powered Telephones. Transmission power is generated by the user's speaking voice.

Your local Graybar Representative and Graybar Signaling Specialist have complete information about all the latest types of apparatus for talking, warning, calling, or locating. They'll gladly help you choose and apply the best combination of equipment and supplies for any signaling or communication project.

Before you begin planning *any* communication installation, you want to know what's new and what's available in apparatus and supplies. Easiest way to find out is call Graybar. Whether the job is big or small, you'll find our nearest office glad to help. *Graybar Electric Company, Inc. Executive offices: Graybar Building, New York 17, N. Y.* 4814

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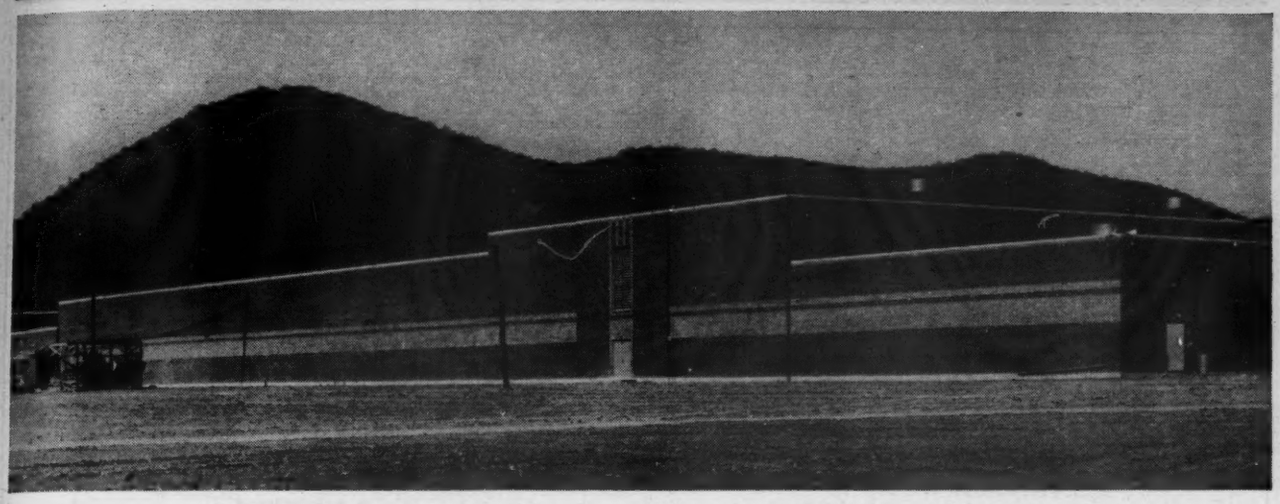


Windowless carpet-yarn mill is latest addition to modern plant at Glasgow.

LEES . . . of GLASGOW

Electrical installation for a 17 acre wool processing and textile weaving plant includes underground high-voltage distribution network, air conditioning, duplicate-circuit emergency lighting, new automatic machinery, color conditioning and extensive use of pushbutton controls. Electrical work was provided by Bryant Electric of High Point; engineering by Ballinger of Philadelphia.

By Hugh P. Scott

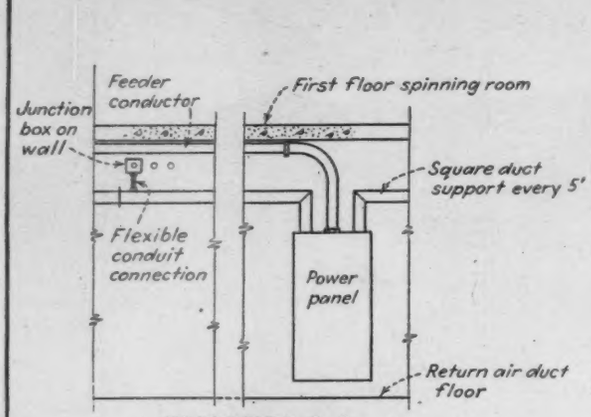
WITH the completion of a tradition-shattering spinning mill and dye house, the James Lees and Sons Company has established one of the world's most modern wool processing and textile weaving plants in Glasgow, Virginia. The completion of the new mill increases the plant's total floor area to over 600,000 square feet; a manufacturing area of approximately 17 acres on a single floor and under a single roof.

In the construction of this huge, modern plant, the Ballinger Company of Philadelphia was employed as architect and engineer. The Bryant Electric Company, Inc., of High Point, North Carolina, was the electrical contractor. The Daniel Construction Company was the general contractor.

The construction and operational story is essentially an electrical one—for all spinning mill machinery is motor driven, much of it pushbutton controlled.

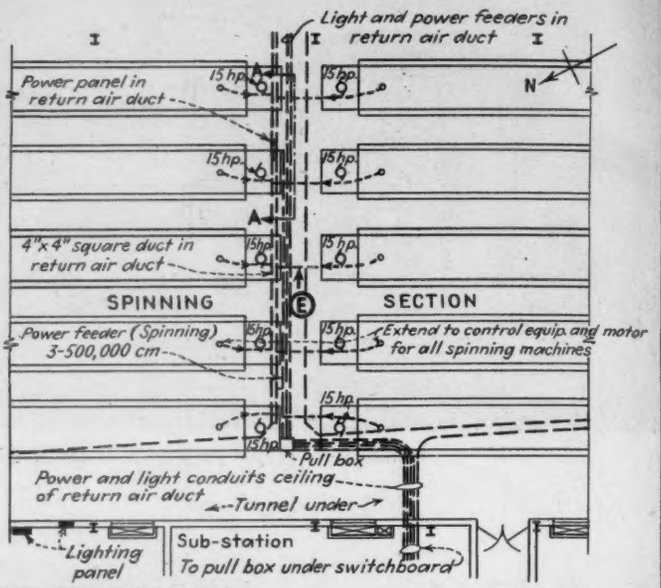
Future expansion is more than a mere dream, for a decade-old construction program is still in progress. Originally designed for Wilton and Velvet weaving, the plant already has been enlarged to include an Axminster mill and the most modern facilities for spinning and dyeing wool fiber. Other buildings house the primary switchgear, pumping and filtering equipment, boilers, machine shops, offices and garage facilities. Plants for treating industrial wastes and sewage are part of the development. Wells, reservoirs, parking areas and recreation fields adjoin the main buildings, illuminated at night by both pole and building-mounted floodlights.

High-voltage transformer equipment, initially designed and constructed for twice the then-existing electrical demand, has already become overloaded and is now replaced by a new and larger main substation, again designed for double present requirements. And building plans, already in blue-



ELEVATION A-A

SHOWING DETAILS OF TYPICAL ELECTRICAL EQUIPMENT IN UNDERFLOOR AIR-RETURN TUNNEL


Light and power feeders in return air duct
Power panel in return air duct
15 hp.
4"x4" square duct in return air duct
SPINNING
SECTION
Power feeder (Spinning) 3-500,000 cm
Extend to control equip. and motor for all spinning machines
Pull box
Power and light conduits ceiling of return air duct
Tunnel under
Lighting panel
Sub-station
To pull box under switchboard
N

NORTHWEST SECTION OF SPINNING MILL

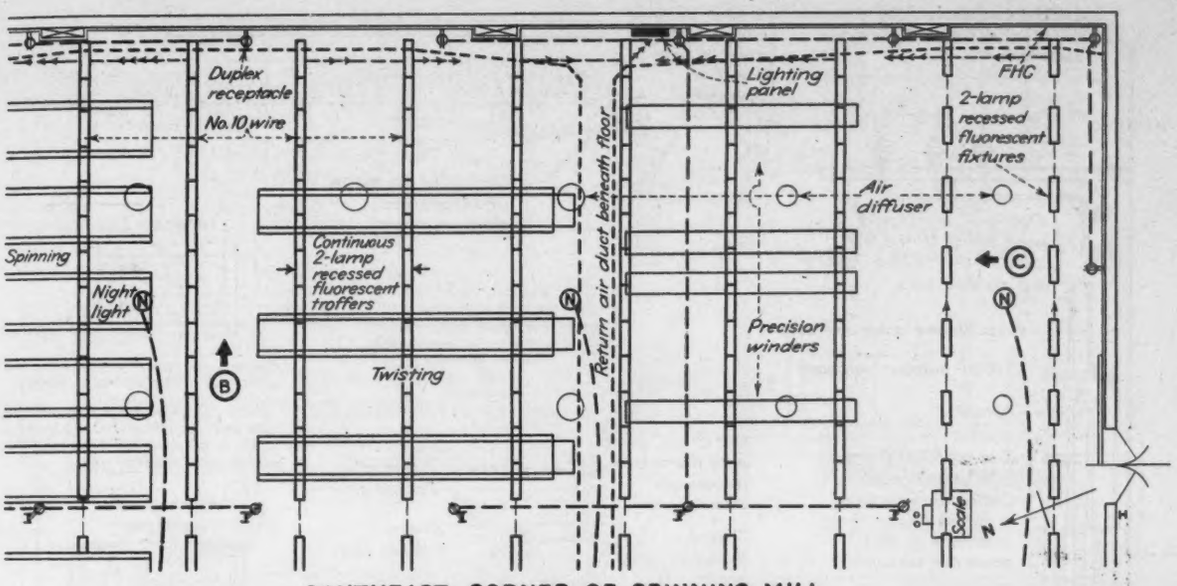
Section of spinning mill power plan (above) indicates feeders, pull boxes and distribution panels located in sub-floor air-return tunnels. Detail drawing shows arrangement of square 4-by-4 ducts and feeders at power panels. View of tunnel (left; looking from point E) pictures conduit connections between square duct and control equipment for 15-hp. spinning machine motors on floor above. Installation view (below; also taken from point E directly over tunnel) shows electricians of Bryant Electric Company installing machine controllers, using labor-aiding power tools. With housings removed, intricate gear assemblies of spinning machine are visible.

print form, speak of continued growth.

Functionally planned, the plant is the only integrated carpet mill to be designed for continuous straight-line production on a single floor. Here, with new methods and new machinery, it is possible to process wool from the time it is sheared until it rolls from the looms as finished carpet.

The most recent structure to be completed is a 3½-million dollar 450-by-309-foot windowless spinning mill of vault-type construction, with structural steel skeleton, masonry walls and the largest pre-cast Hadyte roof in the world. Exterior walls are modern red and grey brick. Interior walls are faced with acid-resisting glazed tile, selected to permit hosing and reduce maintenance. Concrete floors, in accordance with the utilization of specific areas, are variously surfaced with cement, wood, brick, asphalt and flexichrome tile. For example, creosoted block is used in machine shops, offices are floored with asphalt tile, rubber tile is utilized in laboratories, while acid-proof brick paves the skein dye house. Ceilings, ranging in height from 15 to 28 feet, are acoustical.

This new building is completely air conditioned. RCA public address equipment is installed for high fidelity musical transcriptions and voice announcements. Color conditioning, in accordance with the DuPont color code, has been employed for safety and morale. Protection against fire damage is obtained from an automatic sprinkler system. Planned lighting



SOUTHEAST CORNER OF SPINNING MILL

maintains IES standards of illumination. Sub-floor walk-through tunnels, also serving as return air chambers for the air conditioning system, carry electrical power feeders throughout the plant.

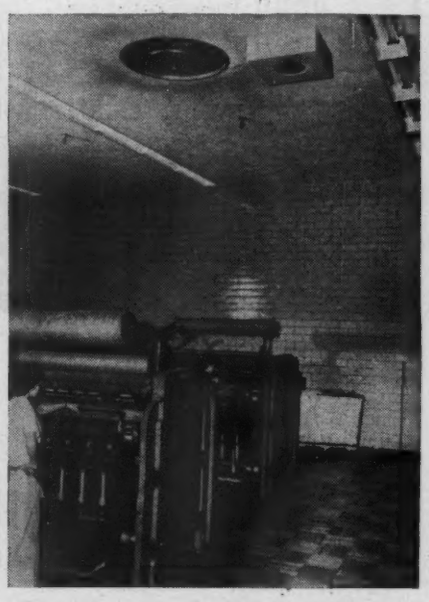
The spinning mill proper occupies an area roughly measuring 280 by 170 feet; an entirely open section with continuous fluorescent lighting troughs and conditioned-air diffusers recessed into the acoustical ceiling which is smooth except for a pattern of sprinkler heads.

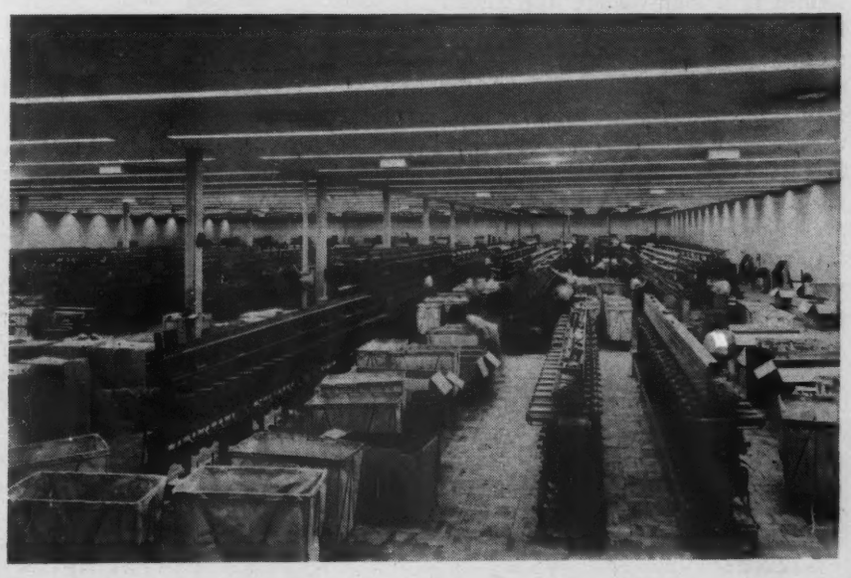
Four separate electric stations control the completely automatic scouring room. Automatically regulated are temperatures of air, water, scouring bowls and driers. Also automatic and electrically controlled is the flow of water and the tension of the squeezing apparatus. Powerful electro-magnets extract mineral particles from the raw wool stock.

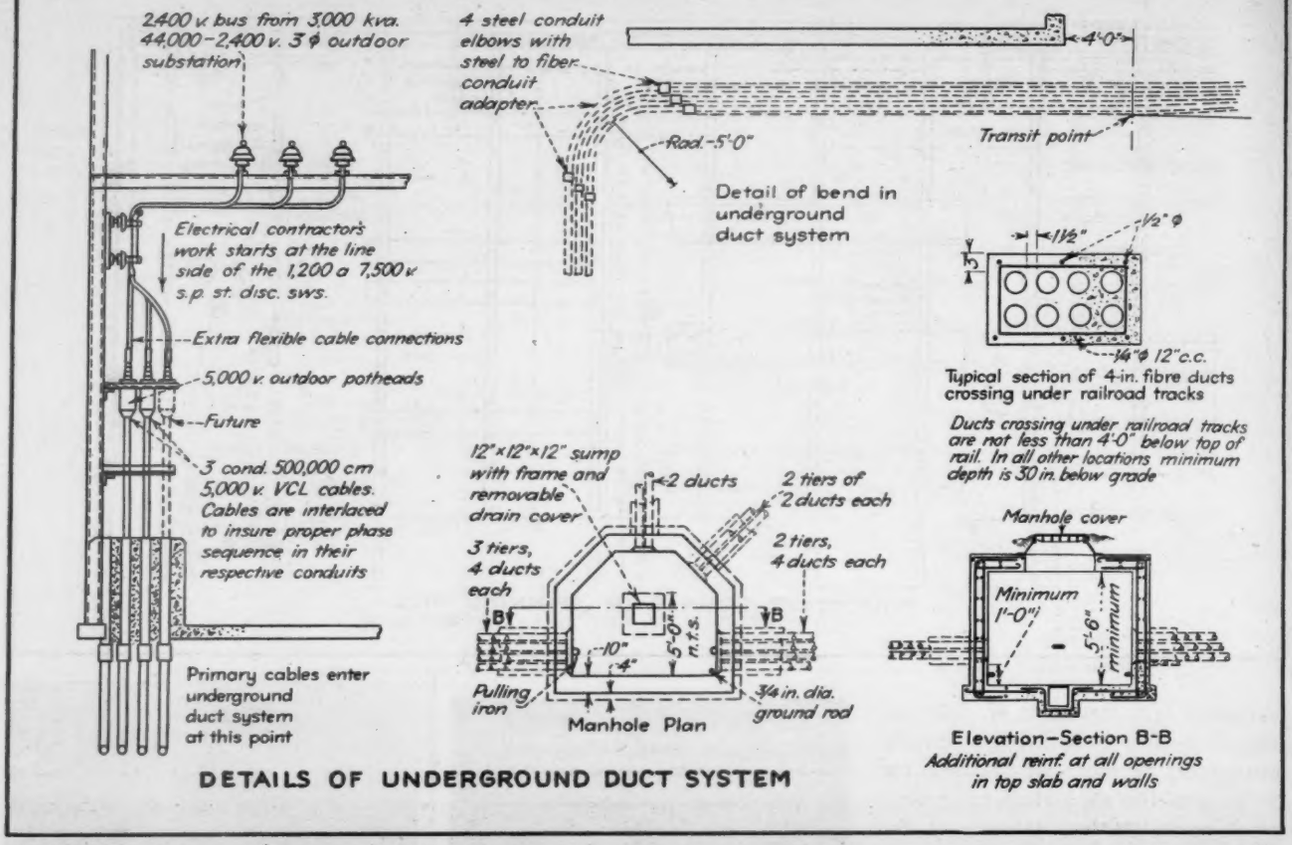
In the modern blending room, all operations are pushbutton controlled. Bulk movement of wool is by overhead and floor-level conveyors as well as by compressed air passing through 14-inch pipes. Moisture content of the wool fiber is electrically held at an even 16 percent.

The dye operations are primarily automatic or pushbutton controlled. A 5-ton monorail system, four 15-ton cranes, compressed air tubular conveyor and kettles motored for centrifugal moisture extraction conserve time and labor. A 40,000-gallon water tank is automatically held at 185 de-

Partial lighting plan of spinning mill (above) indicates locations of recessed 2-lamp open-bottom fluorescent fixtures, night lights, lighting panels, receptacles, air diffusers and sub-floor air-return tunnels in relation to winding, twisting and spinning equipment. Circular air diffusers, square public address speakers and patterns of sprinkler heads are ceiling-mounted between lighting units (right; view from position B). Huge area (below; from position C) is walled with salt-glazed tile and is floored by maple parquet over a concrete base. Color conditioning includes white beams, light grey and ivory columns, and medium grey doors and frames.






2400 v. bus from 3,000 kva. 44,000–2,400 v. 3 ϕ outdoor substation
Electrical contractors work starts at the line side of the 1,200 a 7,500 v. s.p. st. disc. sws.
Extra flexible cable connections
5,000 v. outdoor potheads
Future
3 cond. 500,000 cm 5,000 v. VCL cables. Cables are interlaced to insure proper phase sequence in their respective conduits
Primary cables enter underground duct system at this point
4 steel conduit elbows with steel to fiber conduit adapter
4'-0"
Rad.-5'-0"
Transit point
Detail of bend in underground duct system
1½"
½" ϕ
14" ϕ 12" c.c.
Typical section of 4-in. fibre ducts crossing under railroad tracks
Ducts crossing under railroad tracks are not less than 4'-0" below top of rail. In all other locations minimum depth is 30 in. below grade
12"x12"x12" sump with frame and removable drain cover
2 ducts
2 tiers of 2 ducts each
2 tiers, 4 ducts each
3 tiers, 4 ducts each
B
B
10"
4"
5'-0" n.t.s.
Pulling iron
¾ in. dia. ground rod
Manhole Plan
Manhole cover
Minimum 1'-0"
5'-6" minimum
Elevation–Section B-B
Additional reinf. at all openings in top slab and walls

DETAILS OF UNDERGROUND DUCT SYSTEM

Underground fiber duct system starts at outdoor substation where cables carrying 2400 volts are interlaced for proper phasing and are conducted below grade through concrete housing. Distribution to main switch house and thence to 2400/480-volt substations is via buried 4-inch fiber ducts in reinforced concrete protective envelopes. Changes in feeder direction are made by elbows with steel-to-fiber conduit adapters.

grees, and five 500-pound pressure kettles are also temperature regulated through the controlled use of steam.

Distribution

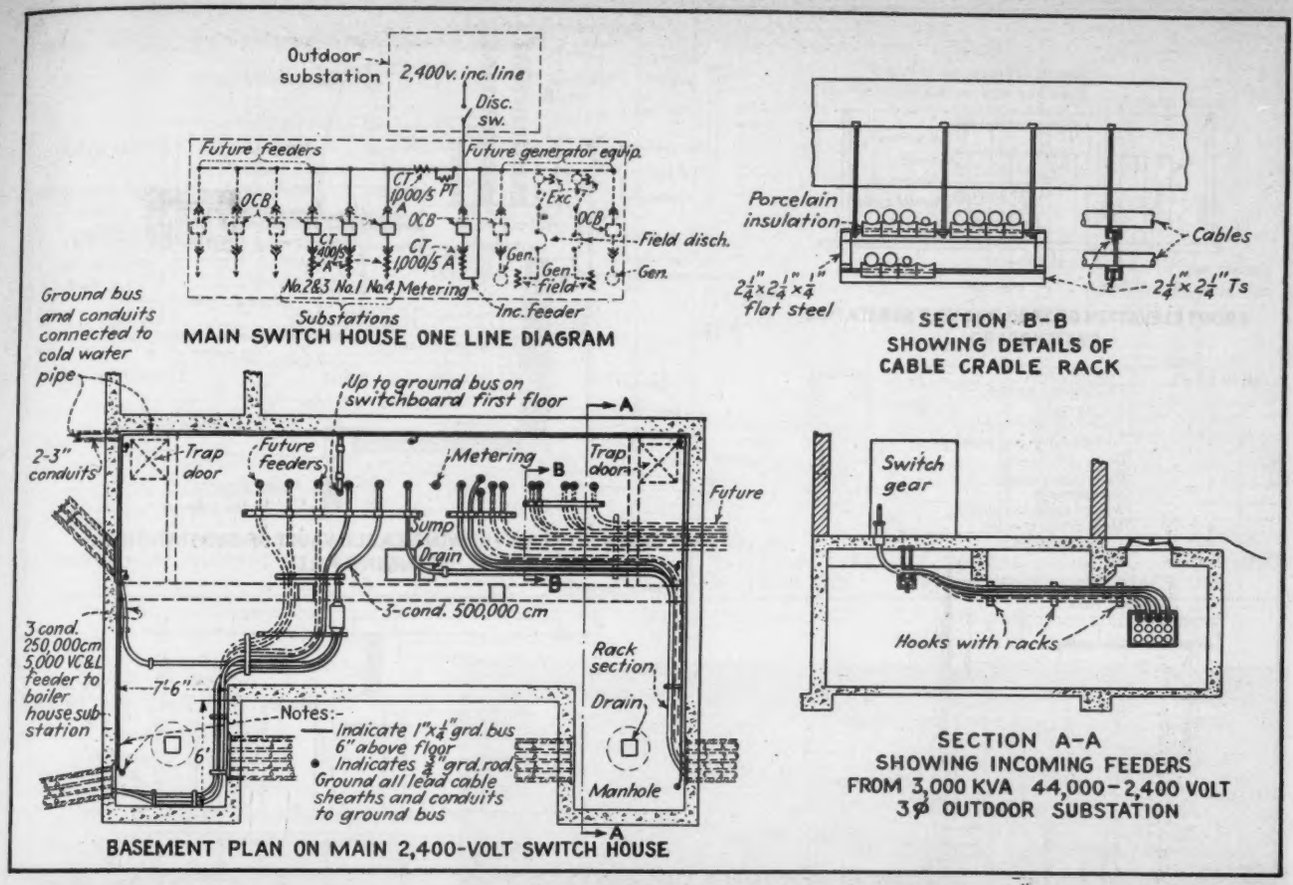
Primary service at 44,000 volts, supplied by the Virginia Electric and Power Company, is initially transformed to a high-voltage distribution level of 2400-volt, 3-phase, 60-cycle by means of a 3000 kva. outdoor substation. Feeders from this substation to the main switch house are underground, consisting of three sets of 3-conductor 500 MCM lead-covered cables in parallel. At the substation terminal, feeders are tapped to a 2400-volt bus system through 1200-amp., 7500-volt disconnect switches and 5000-volt outdoor potheads where cables are interlaced to insure proper phase sequencing in the respective conduits.

Underground feeders are carried in four parallel runs of fiber ducts to a central manhole and, from this point, continue unbroken to the basement of the switch house. The fiber ducts, typical of those used for the entire underground distribution system, are 4 inches in diameter, separated from each other by 1½ inches of concrete and boxed with a 3-inch protective overall casing of concrete on all exterior sides. Ducts are carried at a minimum of 30-inches below grade in all cases and, in load-bearing locations such as beneath the railroad siding, concrete is reinforced both laterally and longitudinally and trench depths are increased to 4 feet. Underground duct runs are installed so that drainage is away from all building entrances. Where changes in duct direction are necessary at points other than at manholes, turns are effected through steel conduit elbows with steel to fiber conduit adapters having minimum radii of 5 feet. Although only four fiber ducts are required to carry primary feeders from the substation to the switch house, some sections of the underground distribution system combine as many as a dozen parallel ducts in the encasing concrete envelope. In the switch house basement, cable conduits in two tiers are carried by porcelain cradle insulators supported by T-bar racks and round steel hangers. Cable connections to metal-clad switchgear cubicles are through steel floor collars.

Primary service to the main 2400-volt switchboard is through an incoming 1200-amp. circuit breaker. Connections from switchgear to the three main feeder circuits are through 600-amp. breakers. Breakers are removable, 3-pole, fully automatic, electrically operated assemblies with interrupting capacities above 100,000 kva. at nominal service ratings. Switchgear cubicles, connected through a bus structure, are equipped with the usual recording meters and overload relays.

The three main underground feeder circuits serve four 1500-amp. 2400/480-volt unit-type substations strategically located in the Wilton-Velvet, Axminster and spinning mills.

In the case of the spinning mill substation, cables of the feeder circuit enter a sub-floor cable vault through a transite wall pullbox and then sweep upwards through the first floor slab



Basement plan of switch house indicates routing of feeders between underground duct entrances and switchgear cubicles. Cables are supported by porcelain insulator cradles on suspended cable racks and are carried to points directly beneath panels before piercing floor through steel collars. All circuit breakers are removable, 3-pole, fully automatic, electrically operated assemblies. Emergency generator is housed in wing.

to the primary switch cubicle. Removable front and bottom panels on the pullbox facilitate cable pulling. Junction boxes are constructed directly beneath and above the entire area occupied by the 480-volt distribution switchboard. Eleven separate feeders (each consisting of 3 conductor 500 MCM cables) emanate from the low-voltage side of the substation switchboard, enter these junction boxes and then proceed to local lighting and power load centers in the various mill areas equipped for wool blending, carding, spinning, twisting, winding, scouring and skein dyeing.

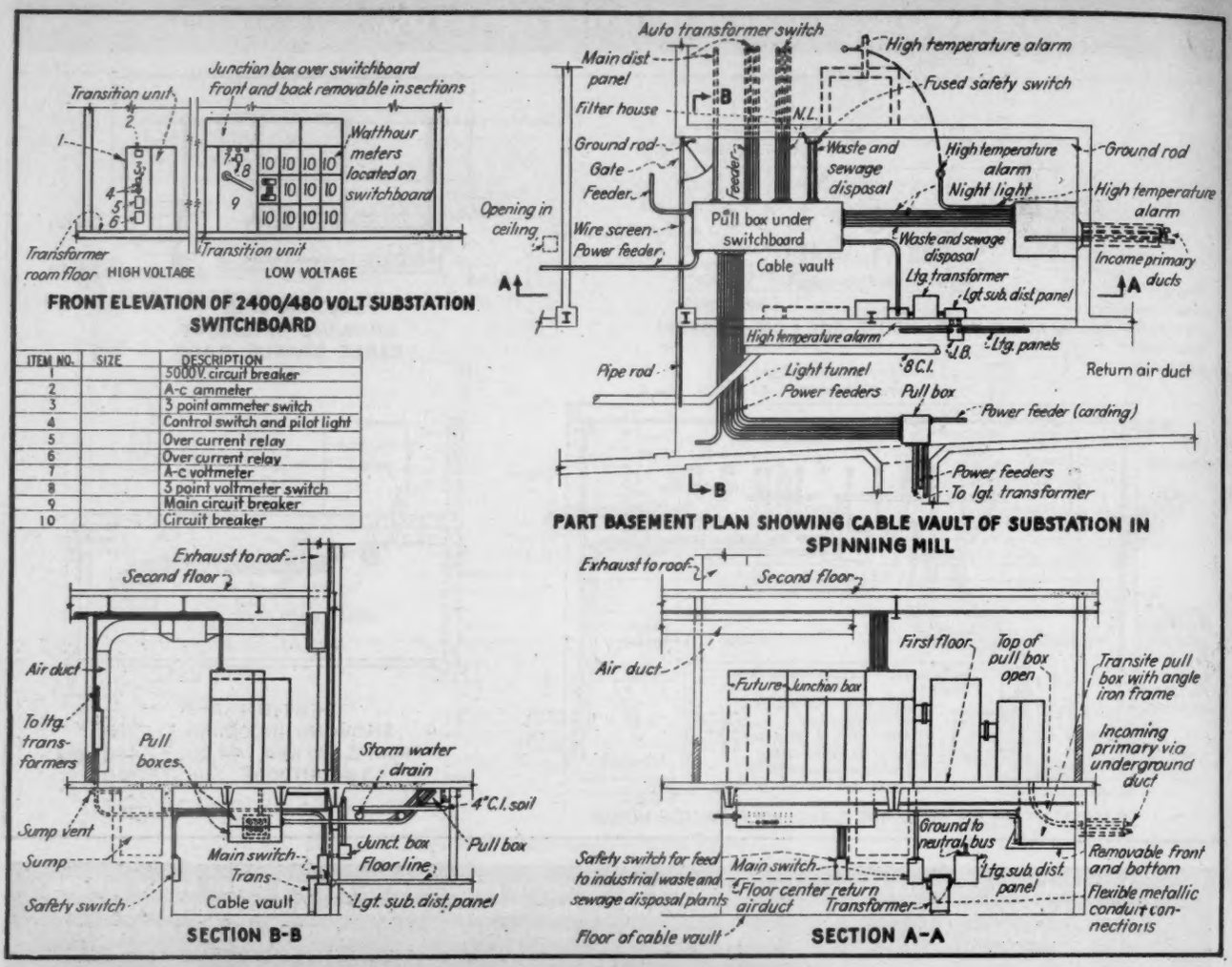
Local load centers control conveyors, condensers, fans, pumps, dryers, machine tools, unit heaters, washers, machines for spinning, carding and reeling, equipment for loading and dyeing, cranes and hoists. In all, load centers in the spinning mill alone control 260 motor branches and 504 lighting circuits.

The main bus structure of this 2400/480-volt substation is designed to carry 3000 amps. Busses at both ends of the switchboard are drilled in anticipation of future extensions to additional secondary cubicles. Connection busses are braced by ebony asbestos clamps. To facilitate cable connections and to support secondary feeders, the junction boxes are formed with removable sections and are equipped with suitable insulated cable racks. All non-current-carrying metal parts of the substation, and all other electrical equipment both in the first-floor substation room and in the cable vault below it, are connected to a copper ground bus which extends around the entire substation areas at an approximate height of 6 inches above the floor level.

While power is predominantly 480-volts, dry type transformers reduce this level to 120/240-volts for lighting and lifting equipment. Lighting transformers are single phase units having 2-wire primary windings and 3-wire secondary windings. In all there are seven of these lighting units in the new spinning mill, ranging from 7.5 to 75 kva. in capacity. Night light circuits in this building are served by a 7.5 kva., 3-phase unit having a 3-wire delta primary winding and 4-wire wye secondary. Lifting machines and the monorail system are served through 3-phase delta-delta units.

Emergency Lighting

Since the new building is windowless vault construction, it is imperative that continuous lighting is insured for safety. For this reason, an emergency lighting system, with separate panelboards, switchless circuits, outlets, automatic transfer switches, relays and a gasoline-driven generator with all necessary controls, is installed. The night light branch circuit panel is normally supplied through dry-type transformers fed from the 480-volt feeder system but, upon failure of this system or upon a 30 percent reduction in line voltage, the lighting load is automatically transferred from the normal supply to the engine-driven emergency lighting generator which is located adjacent to the main switch house. Automatic transfer takes place



FRONT ELEVATION OF 2400/480 VOLT SUBSTATION SWITCHBOARD

ITEM NO.	SIZE	DESCRIPTION
1		5000V. circuit breaker
2		A-c ammeter
3		3 point ammeter switch
4		Control switch and pilot light
5		Over current relay
6		Over current relay
7		A-c voltmeter
8		3 point voltmeter switch
9		Main circuit breaker
10		Circuit breaker

PART BASEMENT PLAN SHOWING CABLE VAULT OF SUBSTATION IN SPINNING MILL

SECTION B-B

SECTION A-A

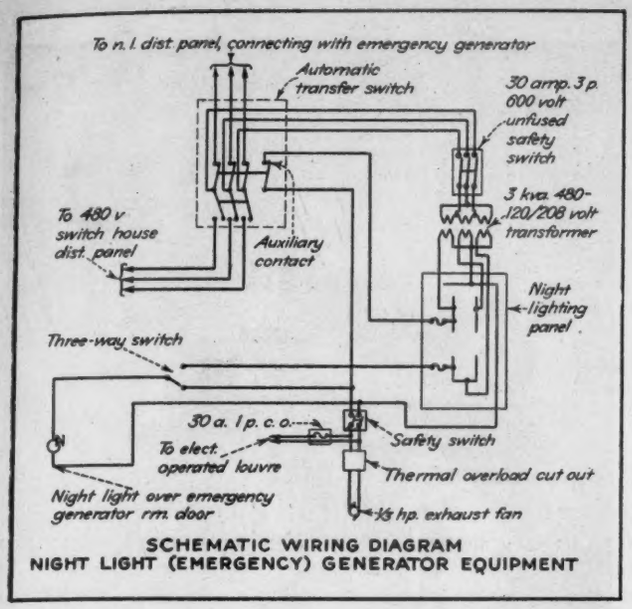
Underground duct system carries high voltage feeders to 2400/480-volt substations. Low voltage distribution is mainly below floors in air-return tunnels or above suspended acoustical ceilings. In new building, local load centers are located in areas equipped for wool blending, carding, spinning, twisting, winding, scouring and skein dyeing. (above)

Vaporproof fixtures illuminate acid-resisting tiled area housing huge stainless-steel dye kettles. Power feeders for kettle motors are carried along basement ceiling. Overhead monorail system with extensive interlocking switching facilities handles wool stock. (below)

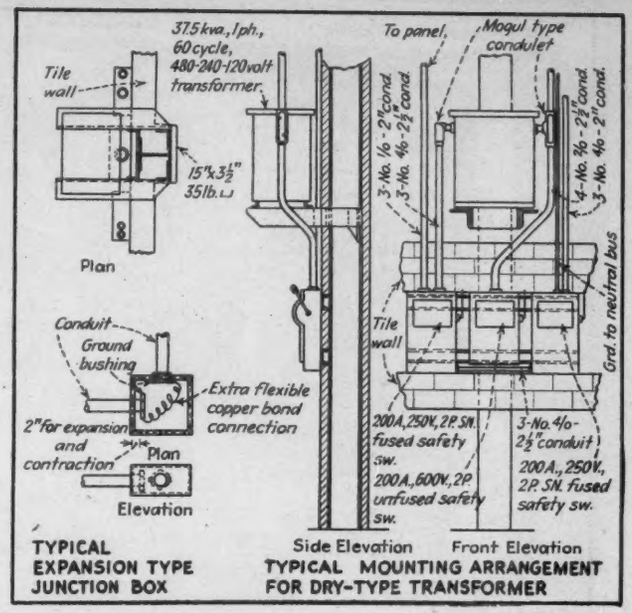
in 15 seconds. On restoration of 90 percent of normal voltage, the load automatically returns to the normal supply.

The 25 kva. emergency generator is driven by an internal combustion gasoline water-cooled engine which, in turn, is started by means of a d-c generator acting as a motor and supplied with current from a set of 32-volt storage batteries. Storage batteries are constantly charged by a 120-volt a-c trickle charger.

For both power and lighting, all wiring is rubber insulated and predominantly installed in rigid steel conduit which is run exposed at right angles with building lines and securely supported, run concealed in concrete slabs, or run concealed above suspended ceilings. In sections where tile walls are periodically washed down by hosing, conduits, fittings and outlet boxes are mounted an inch away from the walls. Outlet boxes and fittings are cast iron and gasketed to prevent the entrance of water. Switch and receptacle fittings are weatherproof construction. Wrought iron sleeves are used wher-


To n. l. dist. panel, connecting with emergency generator
Automatic transfer switch
30 amp. 3 p. 600 volt unfused safety switch
3 kva. 480-120/208 volt transformer
To 480 v switch house dist. panel
Auxiliary contact
Night lighting panel
Three-way switch
30 a. 1 p. c. o.
To elect. operated louvre
Safety switch
Thermal overload cut out
Night light over emergency generator rm. door
⅓ hp. exhaust fan

SCHEMATIC WIRING DIAGRAM
NIGHT LIGHT (EMERGENCY) GENERATOR EQUIPMENT


37.5 kva., 1 ph., 60 cycle, 480-240-120 volt transformer
To panel
Mogul type conduiet
Tile wall
15"x3½" 35 lb. CI
Plan
3-No. 1/0 - 2" cond.
3-No. 4/0 - 2½ cond.
4-No. 3/0 - 2½" cond.
3-No. 4/0 - 2" cond.
Grd. to neutral bus
Conduit
Ground bushing
Extra flexible copper bond connection
2" for expansion and contraction
Plan
Elevation
200 A, 250 V, 2 P. SN. fused safety sw.
200 A., 600 V., 2 P. unfused safety sw.
3-No. 4/0 - 2½" conduit
200 A., 250 V., 2 P. SN. fused safety sw.
Side Elevation
Front Elevation

TYPICAL EXPANSION TYPE JUNCTION BOX

TYPICAL MOUNTING ARRANGEMENT FOR DRY-TYPE TRANSFORMER

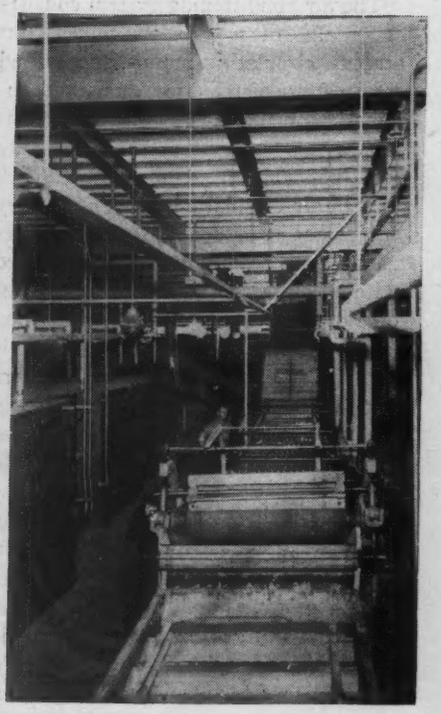
ever electrical lines pierce walls or floors. No conduit is smaller than ¾-inch. No wire is smaller than 12 gauge. All distribution panels are dead front construction. All work was completed in accordance with standards of the National Electrical Code, the Southeastern Underwriters Association and the Virginia Public Service Company.

In addition to underground fiber ducts and rigid conduit construction, square steel ducts are used for wireways in shop areas and in the sub-floor return air conditioning tunnels. The use of plug-in bus-duct is limited to machine shops, since most of the spinning equipment is permanently located and the flexibility of a plug-in system is not a necessity in the plant.

Should main feeder system fail, lighting circuits for windowless spinning mill are automatically transferred to engine-driven emergency generator within 15-second interval. (above, left)

Current for lighting and lifting equipment is 120/240 volts, supplied through dry type transformers mounted on special wall racks. Junction boxes provide for expansion and grounding of conduits. (above, right)

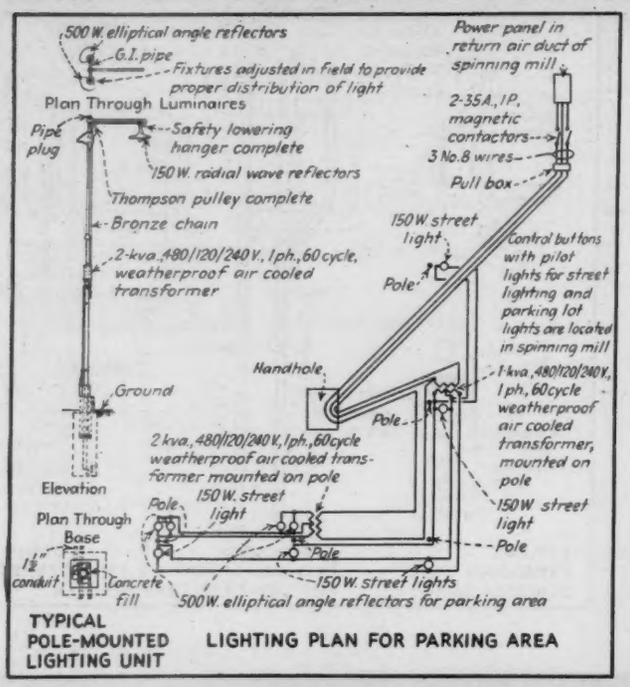
Scouring area, vaporproof lighted, includes numerous motors for wool washers, drying fans, pumps and exhaust equipment. Conveyor duct from exhauster is wye-constructed to carry wool to either blending room or raw stock loading area. Outlet boxes, fittings and panels are mounted away from tile to permit use of hose when washing walls. Power circuits are carried in square cable ducts suspended from ceiling. Smallest wire used in any circuit, power or lighting, is 10 gauge. (below)

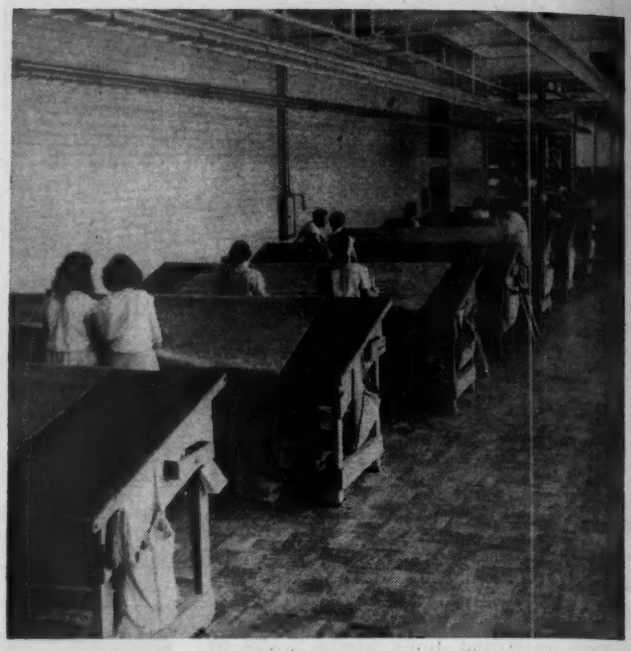


Air Conditioning

An outstanding feature of the new mill development is the huge air conditioning system. The spinning mills and the laboratories are completely air conditioned, while other areas are equipped for correct ventilation, humidification and temperature through automatic electrical controls.

To obtain a favorable heat balance, main fans are turbine operated. Steam from these turbines is condensed in a heat exchanger through which the plant's processing water is routed and heated for industrial use. Water for the air conditioning system is pumped from two 800 gpm. deep wells at 56 degrees and, as a result of air conditioning processes, is stepped to 70 degrees. After filtration and softening, this same water is passed through the turbine condensers that raise water


500 W. elliptical angle reflectors
G.I. pipe
Fixtures adjusted in field to provide proper distribution of light
Plan Through Luminaires
Pipe plug
Safety lowering hanger complete
150 W. radial wave reflectors
Thompson pulley complete
Bronze chain
2-kva., 480/120/240 V., 1ph., 60 cycle, weatherproof air cooled transformer
Ground
Elevation
Plan Through Base
1½" conduit
Concrete fill
Power panel in return air duct of spinning mill
2-35 A., 1P, magnetic contactors
3 No. 8 wires
Pull box
150 W street light
Pole
Control buttons with pilot lights for street lighting and parking lot lights are located in spinning mill
Handhole
1-kva., 480/120/240 V., 1ph., 60 cycle weatherproof air cooled transformer, mounted on pole
2 kva., 480/120/240 V., 1ph., 60 cycle weatherproof air cooled transformer mounted on pole
150 W. street light
150 W street light
150 W. street lights
500 W. elliptical angle reflectors for parking area
TYPICAL POLE-MOUNTED LIGHTING UNIT
LIGHTING PLAN FOR PARKING AREA



Pole-mounted 1000-watt dust-tight and weatherproof floodlights illuminate parking areas. Control buttons with pilot lights are located inside spinning plant. Air-cooled weatherproof transformers for lights are mounted on poles beneath luminaires. Floodlights are also mounted on exteriors of buildings.

Broadloom carpeting is inspected beneath runs of suspended continuous fluorescent troffers having metal cross louvres on 12-inch centers. Wall control panel activates local lighting and unit heaters. Color plan combines white, ivory, light and medium grey. Walls are tiled while floors are of hardwood.

temperatures to 130 degrees, and an instantaneous heater further raises the water temperature to the ultimate process level of 185 degrees. It is noted, therefore, that process water is raised from an initial 56 degrees to the 130-degree level at no cost other than that for pumping.

The air conditioning system consists essentially of a washer, filters, lint screens, circulating pumps, supply and return fans, distribution ducts and automatic controls for humidity and temperature. The system has a capacity for 165,000 cfm., equivalent to 360 tons of air circulation every hour. Key equipment is duplicated so that maintenance and repairs can be completed without interrupting the continuous operation of the system. Distribution of air to the huge spinning room is through stainless-steel ceiling diffusers recessed into the smooth acoustical ceiling. The return air is conducted through wall-mounted grills to the subfloor masonry tunnels which also carry piping and electrical conduits. Air can automatically be controlled throughout the year at a constant 72 degrees with a relative humidity of 65 percent. Variations are confined to ½-degree in temperature and 1 percent in humidity. Unit heaters, installed in air-conditioning ducts and in the attic, provide heat during winter months.

Color Conditioning

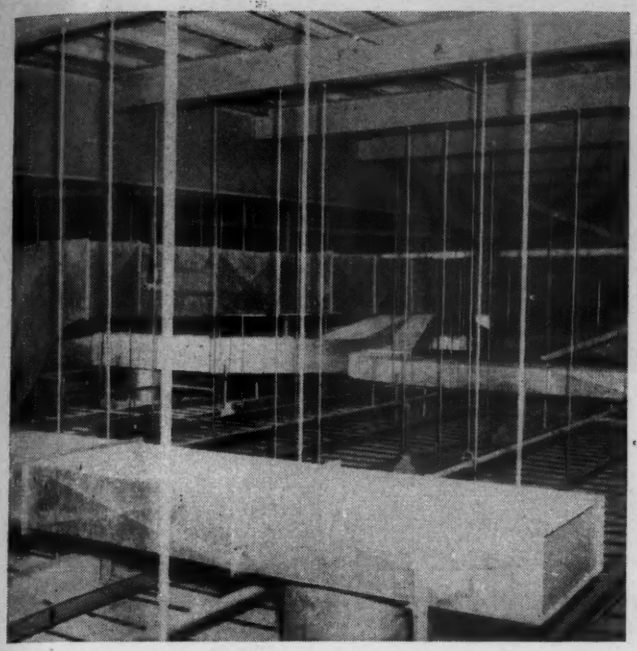
Color conditioning, in accordance with standards and paints developed by the Du Pont company, has been adopted for the entire project. These standards prescribe the functional use of color and are the results of extensive research and experimentation. The color code is designed to increase employee safety, relieve mental fatigue, improve morale, raise efficiency, provide for three-dimensional seeing and the identification of piping and machine tools.

Alert Orange is used on the interiors of fuse box doors. Fire Protection Red identifies all equipment in that category. Precaution Blue marks electrical switches. High Visibility Yellow and Black are used in alternating stripes to indicate overhead projections that should be avoided. This precautionary color treatment is likewise used to mark the top tread and bottom riser of all stairways.

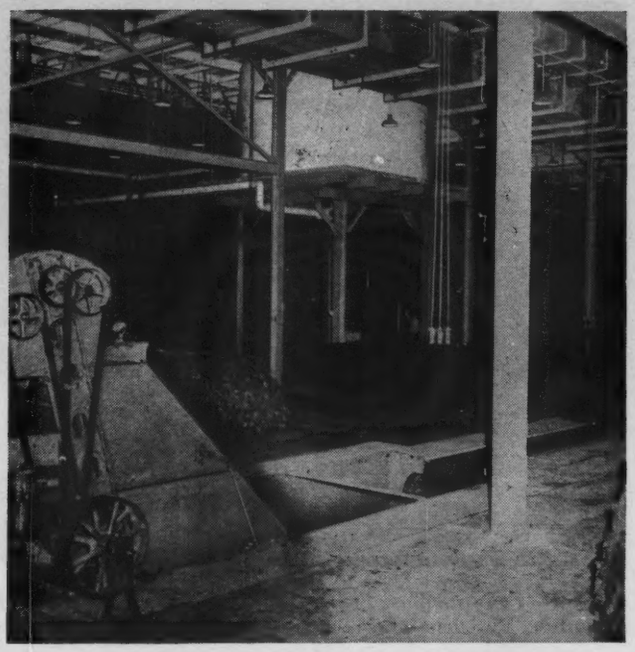
Each room is painted in accordance with its purpose and function. As examples; machine shops have white ceilings, ivory walls and sashes, medium green dados and doors, horizon grey machinery and panelboards. Moving parts of stationary apparatus are toned in spotlight buff. Waiting rooms and offices are treated with white ceilings, light green walls and sashes, and medium green doors and baseboards. Exposed building structural metal in the dye basement is in aluminum with doors and frames in medium grey. Piping is made inconspicuous by employing the same colors as the background, but code bands properly identify the contents and uses.

Public Address

The entire plant is served by a public address system for voice and musical transcription. The apparatus consists of a 10-zone studio console, two transcription turntables, a broadcast receiver, antenna, coupling transformer, amplifiers and microphones. A sound studio is constructed in the dispensary section of the Wilton-Velvet building. From this sound studio to power amplifiers in each zone, signal and control circuits are extended, each circuit consisting of a twisted pair of transposed telephone type wires. From each amplifier to the related sound projectors, circuits consist of twisted pairs of standard type R rubber-covered 14 gauge wire insulated for 600 volts. All



Area above suspended acoustical ceiling in spinning area contains air conditioning ducts, sprinkler pipes, circuits for recessed fluorescent lighting troffers and for public address speakers. Seen from beneath, the ceiling is smooth except for pattern of air diffusers, sprinkler heads, lines of light and the square speakers.



Wool stock is carried to blending area from scouring room on overhead, reversible, motor-driven belt conveyors controlled from floor by means of start-stop pushbuttons suspended on flexible rubber-insulated cords. After being dropped to bins, wool is fed to floor-recessed belt conveyors moving towards pickers.

microphone lines are 2-conductor 19-gauge shielded woven cable. In general, all wiring is run open and properly supported to structural work. Where signal and control circuits must be installed adjacent to power lines or transformers, lines are run in thoroughly grounded conduits to prevent induction. Conduit is also used where mechanical protection is desired. Where wires pass through finished rooms, they are run concealed above the suspended ceilings.

Lighting is installed in accordance with specific areas. Installation plans, mounting heights, type of light sources, fixture designs and intensities conform to the various functional or decorative requirements. Vaporproof or explosion-proof lighting equipment is used in air ducts, air conditioning rooms, showers, skein dyeing areas and wherever safety precautions dictate. Incandescent, fluorescent and mercury lamps are used separately or in combination with or without lenses or louvres to achieve planned results. Emergency circuits with automatic throw-over equipment insure continuity of service in all vault-construction sections.

Planned lighting also protects and provides safety for exterior areas. Floodlights are mounted on the exteriors of buildings to light adjacent property, and pole-mounted 1000-watt dust-tight and weatherproof floodlights illuminate parking areas.

By selecting top-quality raw materials, maintaining personnel efficiency through continuous training programs, and installing the best available electrical and mechanical equipment in up-to-the-minute mills, James Lees and Sons Company are producing fine carpets in the classifications of clear color, Axminister, Wilton and Velvet. All are made in a wide variety of qualities, colors and patterns. Yarns for knitting, crocheting and making hooked rugs are also produced under the established names of Minerva and Columbia. Four plants and 20 offices already are part of this century-old firm, and recently-completed modern showrooms in New York City, Los Angeles, San Francisco and Chicago, created by industrial designer Raymond Loewy Associates, are also promoting excellent customer relations.

Electrical manufacturers who supplied material and equipment for the spinning plant of James Lees and Sons Company at Glasgow, Virginia

Allis-Chalmers Manufacturing Co.
American Transformer Co.
Anaconda Wire and Cable Co.
Arrow-Hart and Hegeman Electric Co.
Automatic Switch Co.
Benjamin Electric Manufacturing Co.
Bryant Electric Co.
Buffalo Forge Co.
Crouse-Hinds Co.
Day-Brite Lighting, Inc.
Edwards and Co.
General Electric Co.
Holophane Co.
Hubbell, Inc.
Hynes Electric Heating Co.
Litecontrol Corp.
Manypenny, J. P.
Miller Co.
Pass and Seymour, Inc.
Phelps Dodge Copper Products Corp.
Russell and Stoll Co.
Sangamo Electric Co.
Sinco
Square D Co.
Triangle Conduit and Cable Co.
Trumbull Electric Manufacturing Co.
United States Motors Corp.
Walker Brothers
Westinghouse Electric Corp.
Wheeler Reflector Co.

Fig. 1—Four shadows are cast by each man on this well lighted football field. Light from several sources on every point in the field makes the play more easily seen by all the spectators.

HOW TO AIM

Aiming floodlights properly is essential to effective sports lighting.

MARKED improvement in many sports field floodlighting installations can be obtained by re-aiming the floodlights correctly. Shadows, poor visibility at far corners of the field, glare in the spectators' eyes, and spotty lighting on the area are all evidences that lights have not been aimed properly. Frequently what seems to be a hopelessly inadequate floodlighting installation of a baseball, football, or softball field can be made highly satisfactory merely by re-aiming the lights without the necessity of adding new equipment.

Generally, if the original installation has been worked out by a competent floodlighting specialist, the number of towers and lights are adequate and properly located. If this is the case and if floodlights have been maintained properly, respotting the lights properly on the field will eliminate all difficulties. Many times, if due to an older installation or for some other reason, towers are not in the best positions or the lighting equipment is inadequate, much improvement can be achieved by aiming the existing lights according to present day practice.

Difficulties with sports field lighting generally resolve themselves into four general conditions:

Predominant shadows

Difficulty in seeing players and ball at remote regions

Excessive glare to players or spectators

Non-uniformity of light on the field.

All or part of these troubles may be present in any one installation. Generally the correction of one difficulty will decrease others at the same time.

Predominant Shadows

Although some shadows are bound to exist by the very nature of floodlighting, they can be minimized by proper spotting of the floodlights. From the illustrations of Fig. 2, it can be seen that maximum darkness of shadow is produced where only one light source is employed and diminishes as the number of sources increases. The greater the number of light sources directing their beams upon a given area, the less objectionable will be the resulting shadows. Light from several directions tends to wash out the ground shadows of the players. At the same time, many sources of light automatically decrease irregular illumination on a ball in flight, making it more readily visible to players and spectators.

A general principle to follow in minimizing shadows is to fan out the lights over quite an appreciable angle from every pole. This results in several different sources contributing light to each area on the field from several angles, or a general meshing together of the complete lighting system. This condition is illustrated by Fig. 1 in which four shadows are cast by each man. This is good practice and indicates adequate overlapping of the light beams from four different sources.

Difficulty in Seeing Players at Remote Regions

This is usually due to lack of sufficient vertical illumination on the players at distant parts of the field. The condition is illustrated in Fig. 3 where a typical football stadium is shown.

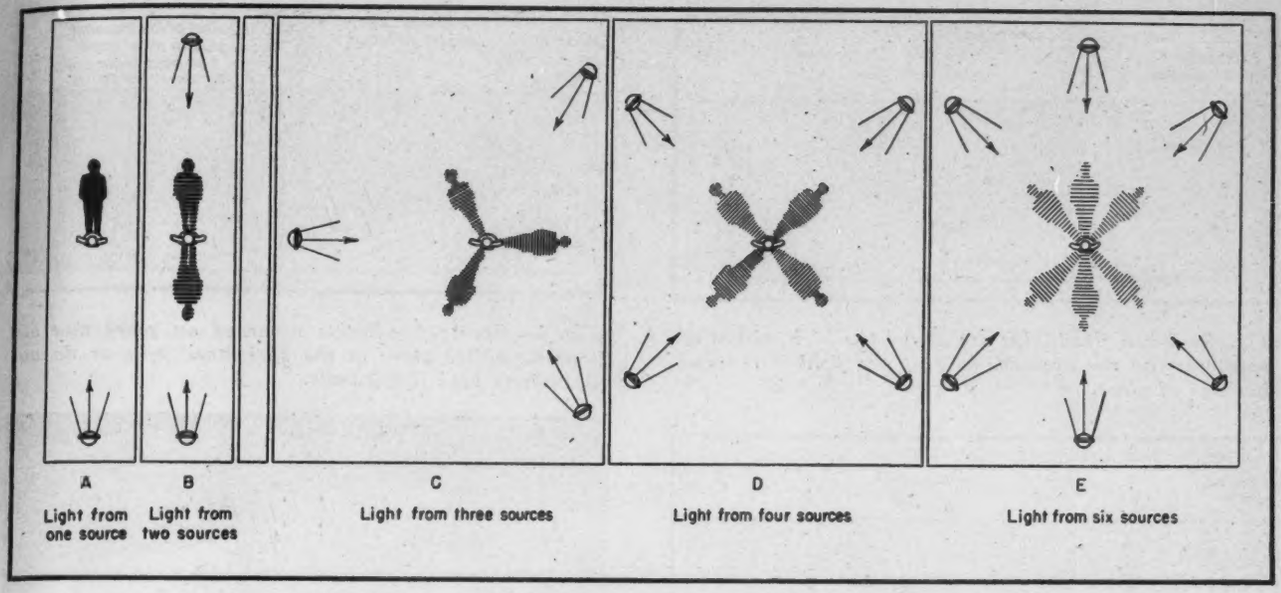


Fig. 2—Shadows occur on floodlighted fields but their effect is minimized by proper aiming of lights. Note how increasing the number of light sources reduces the effect of shadows from "A" to "E".

FLOODLIGHTS

By F. T. Tillemans
Lighting Engineer
Westinghouse Electric Corp.

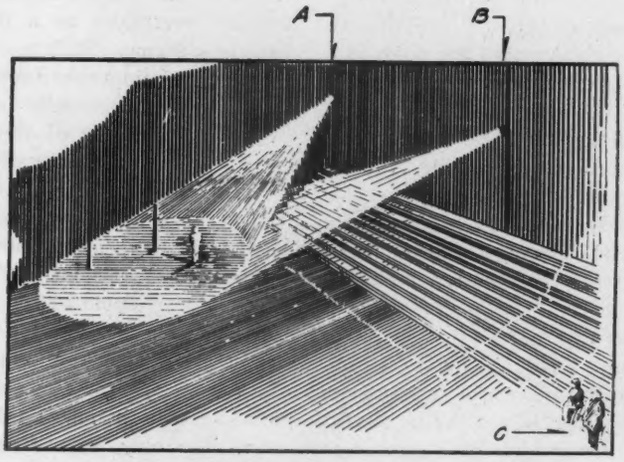


FIG. 3—Lights on each tower should be fanned out over the field so that each spectator receives light from a source near him.

Spectators sitting at the far end of the stadium indicated by "C" see the players at the opposite end zone mainly by means of the light cast by floodlight source "B" rather than by "A". By the same token, spectators at the opposite end of the stand from "C" receive their most effective light from source "A". In each case, light must be directed from a source near a spectator to all portions of the field to illuminate the surfaces of the players on the side toward the spectator.

Generally it will be found that if players are not easily seen at the far corners of the field the individual floodlights at each pole or tower are aimed to concentrate their light in too small an area. In some cases, most of the lights may even be projected straight out from the floodlight poles. Respotting of these lights is required so that the lights from each pole fan out over a sizable arc. A player located anywhere on the field should have some vertical illumination from every source.

Since the remedy for this condition is the same as that for predominant shadows, it will be found that correction of one of these difficulties removes the second one.

Undesirable Glare for Players and Spectators

Excessive glare is the most undesirable lighting condition found in night-time sports. Glare is obviously not wanted, for it seriously hampers everyone's vision and represents wasted light as well since it is usually projected off the field to no useful purpose. Fig. 4 illustrates a very common glare condition on a football stadium. An appreciable portion of the light beam is directed across the football field into the seats thereby partially blinding the spectators. At the same time this portion of the light is kept from the field where it is required.

This particular difficulty results from any one, or combination of the following conditions:

1. Floodlights aimed too high into opposite stands.
2. Mounting height too low.
3. Vertical beam spread of floodlights too great.

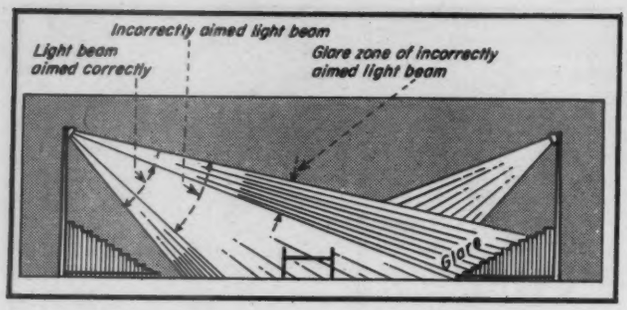


Fig. 4—When floodlights are aimed too high, vision of spectators on the opposite side of the field is reduced because of glare.

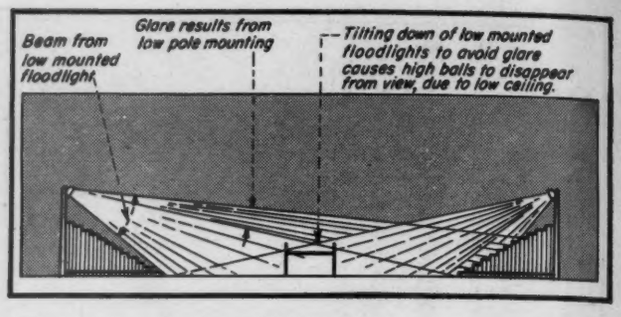

Beam from low mounted floodlight
Glare results from low pole mounting
Tilting down of low mounted floodlights to avoid glare causes high balls to disappear from view, due to low ceiling.

Fig. 5—Sports floodlights mounted on poles that are too low either glare in the spectators' eyes or do not illuminate high-flying balls.

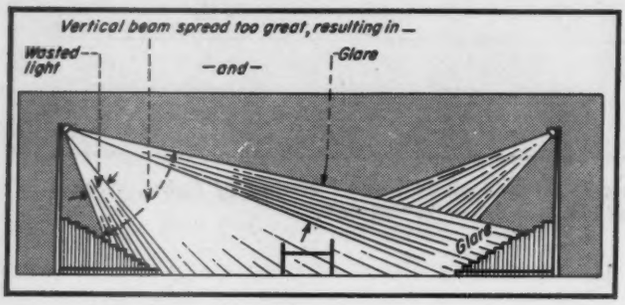


Fig. 6—Floodlights with too great a vertical beam spread waste light and cause glare.

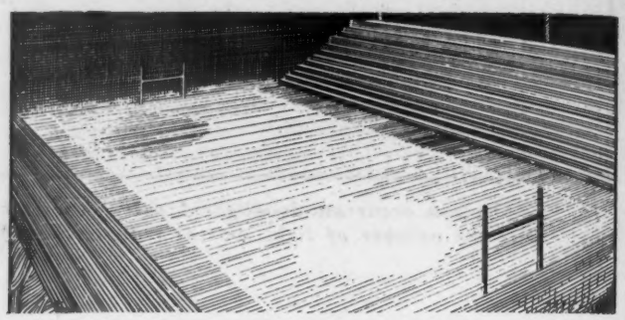


Fig. 7—Hot spots and dark spots on the field result when lights are aimed incorrectly.

Reduction of Excessive Glare

1. If the glare is caused by the floodlights aimed too high as shown on Fig. 4, correction of the fault is relatively simple. It is merely necessary to tilt down the beams until they are no longer objectionable. This solution is possible only if the floodlights are mounted high enough in the air with respect to the distance away from the playing field, and their vertical beam spreads are not too great. Low mounting means critical cutoff between the field and opposite stand.

2. If the mounting height of the lights is too low with respect to the distance away from the playing field, as indicated in Fig. 5, no practical amount of readjustment of the lights will successfully accomplish a satisfactory reduction in glare. If the lights are tilted down to avoid glare to spectators, the beams fall short of the field thereby wasting most of the light. Another condition introduced by tilting the lights down too much is "low ceiling height". The tops of the beams are cut off too low resulting in relative darkness a few feet above the ground at some points. This will cause high balls to fade out temporarily in the dark zones above the beam tops. The only satisfactory solution here is to either increase the mounting height of the floodlights by employing longer poles or else, if practical, to move the poles closer in towards playing field.

3. In some sports lighting projects, it is necessary to install the poles at a considerable distance from the edge of the field. This sometimes entails the use of 100-ft. poles and occasionally towers of even greater heights. A floodlight must be selected whose vertical beam spread is not much greater than that required to cover the field. If the beam is excessively greater as shown in Fig. 6, the top portion of the floodlight beams will glare into the eyes of the spectators across the field. The importance of this glare will depend upon the candlepower of the beam top as compared to the high candlepower of the center of the beam. Often this beam top is not powerful enough to be objectionable across the stadium, but it should be investigated in cases where tilting down the floodlights has not proven successful.

Non-Uniformity on Field

Occasionally illuminated fields appear brighter in some areas than in others. While certain areas where faster action takes place such as the infield of baseball and softball fields and the goal-line region of football areas are purposely highlighted, unrelated "hot spots" on the field are definitely undesirable.

These hot-spots, as indicated by Fig. 7, stand out very noticeably to the average spectators as a flaw in the lighting scheme. Such a condition is the result of improper spotting of the lights and can generally be remedied by re-aiming some of the lights directed upon this excessively bright area to areas less brightly illuminated.

Sometimes hot-spots appear to exist but are actually an illusion produced by differences in color of the earth or grass. For example a bare spot of light clay will give the effect of being much brighter than surrounding areas of black earth or grass, yet actually the intensity of light may be the same all over. The only way to be sure is to take footcandle readings with the proper type of instrument at various points throughout the field, and then if appreciable variations exist, certain floodlights can be re-aimed to produce more uniform illumination.

Excellent sports field floodlighting installations can produce unsatisfactory results when the lights are aimed poorly. Inspection of any floodlighted sports area should quickly reveal any of the common aiming faults. These can be resolved into their probable causes and simple corrective measures taken. In many cases, even inadequate floodlighting installations can be improved by spotting the lights correctly on the various standards.

Economic Outlook

Capital expenditures budgets for 1948 are an accurate measure of what's in store for electrical construction. Here summarized are some significant guide posts from a nation-wide survey.

YOU can expect the boom to run on well through 1948. But old-time competition is close upon us. And look out for trouble in 1949.

These are the main conclusions distilled from McGraw-Hill's nation-wide survey of business' plans for spending on new plant and equipment. They come from these major findings:

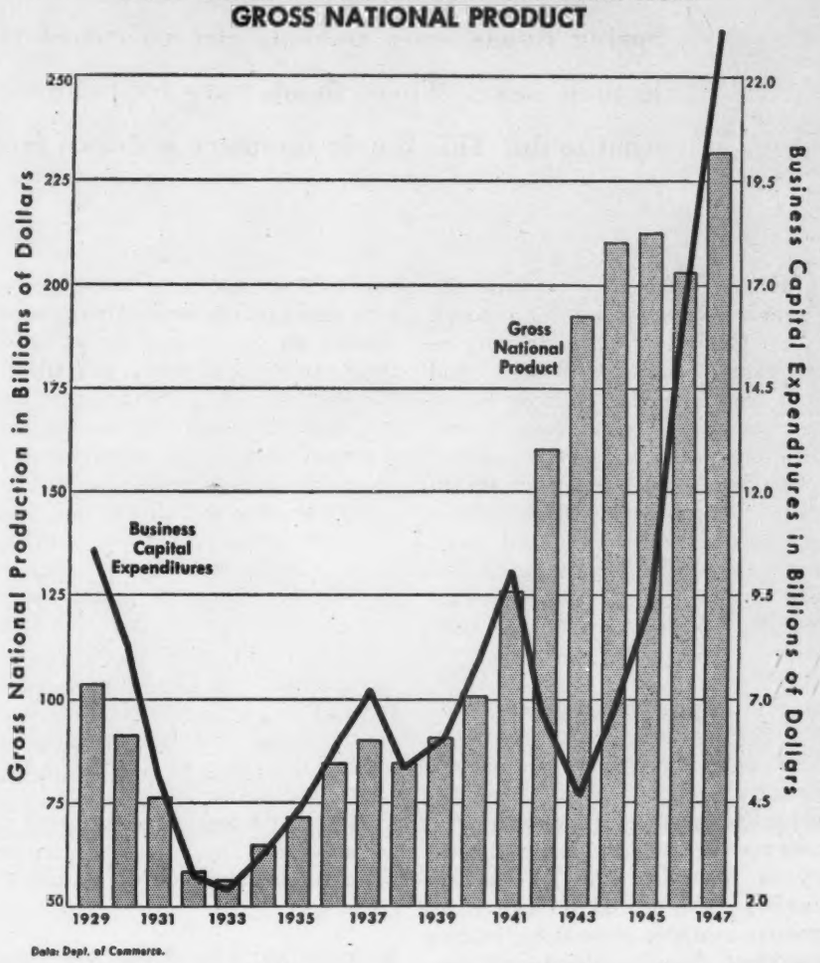
1. Capital expenditures in 1948 will be lower—but only 8 percent lower—than in 1947.
2. In 1949, however, capital expenditures promise to be much lower. Historically, general business has been geared closely to capital expenditures in the ups-and-downs of the business cycle. So, if capital expenditures go down in 1949, all business is likely to fall off with them.
3. Industry's postwar expansion will roll on through 1948, but will be 85 percent complete at the end of the year. When finally complete, American industry will have more than half again the capacity it had in 1939. This doesn't mean the end of capital expenditures. Business will still need to invest much more. President Truman sets an investment goal over the next few years of $50 billion.

But this does mean that tough competition is coming back fast.

There is much in the survey to reinforce the conclusion that the boom will run on in high gear this year.

There is also good evidence that the boom may run out next year unless something is done to encourage business to spend far more than is in sight now.

HOW CAPITAL EXPENDITURES COMPARE WITH GROSS NATIONAL PRODUCT



Data: Dept. of Commerce.

These are solid facts, based on plans firmly made by a broad cross section of American industry.

The survey shows that the postwar expansion program has more than a year to run. So, at most, business purchases of new plant and equipment this year will decline moderately from last year's record figure. Combined with what was already known about the 1948 outlook for other sectors of the economy, this indicates that the boom will run on through most or all of 1948.

On the other hand, the survey comes up with two findings that promise some severe economic headaches in 1949. According to present plans, business capital expenditures will be cut drastically during 1949.

At about the same time, industry's vastly augmented productive capacity will pour forth a huge flood of most of the products that are hard to buy now. The combination of a slash in business capital investment and a large increase in finished goods production is the stuff out of which business slumps have been made in the past. To prevent that combination from producing a painful setback in 1949 may turn out to be our number one economic problem.

Here are the main outlines of business plans for 1948 on a number of key problems:

1) *Industry's postwar expansion program still isn't complete. It will take more than a year to finish it.*

In the case of manufacturing, top executives report that 62 percent of the postwar program taken as a whole is now complete. According to present plans, 85 percent will be installed by the end of the year. Some manufactur-

[Continued on page 196]

FLOOD REPAIRS

Spring floods leave sodden, dirt encrusted electrical equipment in their wake. Where floods have hit before electrical men know what to do. This timely summary is drawn from their experience.

WHEN Spring thaws release the accumulated snows of a rough Winter into swollen streams, we can expect extensive floods. And floods leave behind a clean-up job of huge proportions for electric motor repair shops and electrical contractors.

This is a good time, therefore, to review the problems and procedures that flood experience in past years have shown to be important. It is a good time to get set before such an emergency comes to your own community.

When Floods Hit

Flood repair must usually wait until waters subside and vital community services are restored. The repair shop itself may be inundated and equipment beyond immediate use. Temporary quarters must depend on native ingenuity, available generators, heating equipment, cleaning solvents and similar facilities. Generally, however, reconditioning of flood damaged equipment is largely cleaning, drying and re-insulating, and the full shop facilities are not too essential in the emergency stage.

For cleaning, gasoline, naphtha and other solvents can do when water pressure is not available. Temporary generators can furnish light and power, essential because flood cleanup is usually a round-the-clock operation. Salamanders, steam coils or electric space heaters can operate in temporary drying ovens.

The following data, assembled following a serious flood in the Ohio valley gives a detailed account of the specific problems encountered and the methods used.

1. *DRYING IN THE SHOP*—At a Cincinnati shop, two heavily constructed motor storage racks were boxed in to the ceiling, and provided with steam unit heaters. Motors were stacked on the four shelf levels of these two racks by means of a travelling electric hoist. Again at Louisville, one shop made temporary metal frames and used sheets of tin to build several large coke heated ovens.

An industrial specialist in Louisville arranged for temporary use of twelve large ovens in an industrial plant to dry out apparatus. A motor manufacturer built 26 ovens 8-ft. by 8-ft. of asbestos board and lumber frames, using steam coils and fans for circulated air drying. Another shop built several large ovens of this type, and used strip heaters to maintain a temperature of about 110 deg. C.

Most shops took in motors only up to about 150 hp. Larger machines were reconditioned on the customer's premises.

2. *DRYING ON THE JOB*—This drying equipment, set on the customer's premises, ranged all the way from tarpaulin enclosures and salamanders to sectionalized metal ovens equipped with gas heaters. Some of the large local industries set up equipment in their own plants for drying out motors.

In Louisville one chain grocery company had eighty of its stores flooded, while another had sixty-eight. The former company set up a temporary drying and cleaning operation in its own warehouse, under the direction of a special maintenance employee from another city. The conglomeration of water-soaked refrigeration motors, meat grinders and slicers, coffee grinders, cash registers, adding machines and fans, provided a wide diversity of reconditioning work.

At Cincinnati, one large shop sent its men to plants merely to supervise the construction of temporary enclosures, because its shop crew could not be spared to do such outside work. Then after getting large machines on "bake" in various plants, a regular schedule of inspection was followed and periodic insulation tests were conducted and charted, while the drying-out temperatures were also checked.

Large wound rotors and armatures were removed from their machines and set within enclosures on blocks so that hot air could be properly circulated around them. In many cases wet pole windings were removed from d-c motors and generators and sent to shops for reconditioning.

3. *DISMANTLING AND PICK-UP*—Productive efficiency and manpower was kept at the maximum, in the Cincinnati shops, by having customers dismantle and haul their own equipment. When dismantling help was needed by a plant, the work was done by wiremen, thus keeping all experienced shop mechanics busy on reconditioning work. When equipment was ready for delivery the same procedure was followed, wiremen being used where needed to set and connect the reconditioned motors and controllers.

This permitted the regular shop crews to pair up with extra mechanics that were strangers in the shop or with its production methods. As a result some shops were able to double and treble their forces during the emergency period with satisfactory results in production.

4. *DIS-ASSEMBLY AND CLEANING*—After incoming equipment had been properly tagged, most shops separated the equipment into four cleaning operations:

(1) Prepare stators, armatures and other parts, having insulated coils, for the drying ovens.
(2) Check up for new bearings needed.
(3) Clean all metal parts such as end

The Duck River overflowed its banks into low portions of the town of Shelbyville, Tenn.

frames, bases, oil reservoirs, controller cases.

(4) Determine whether any contacts, fibre washers, wood sleeves or rods, or other controller parts were required.

Windings were cleaned of loose mud and sludge with warm water applied under moderate hose pressure. Then they were cleaned of grease and oil, using gasoline and other solvents, applied with fibre brushes and rags.

When the commutator clamping rings were loosened, wet armatures were often found to drain off considerable water, that had seeped in under the commutator. Several shops found it necessary to puncture the insulation layers of field coils of d-c motors and generators, before they were able to dry them out satisfactorily.

Small coils on controllers were usually free of dirt, because of their enclosures. In most cases, however, they had to be removed from their equipment and dried out. Some types of control equipment were dried without removing any of the coils from their panels, after having been washed down with a hose.

Oil and grease was carefully removed from all bearings, with gasoline and other solvents, to make sure no grit could damage shafts or bearings. Old oil in circuit breakers, auto-starters and relay dashpots was replaced. Wood and fibre separators, in some cases, could be used again after being dried.

One large shop baked wet motors before taking them apart, blowing them clean with dry compressed air. The windings were then re-varnished.

Most of the solid motor parts were cleaned, with commercial solvents, and re-painted, but a pressure cleaning system was employed in a Cincinnati shop to good advantage. Here the equipment was placed on a heavy screen near the open top of a submerged 200-gallon steel tank. At 60 lb. pressure, it was possible to wash off old grease quickly.

5. *DRYING TIME AND TEMPERATURE STATORS*—For 5 hp. to 30 hp. low voltage motors baked dry in 12 to 18 hours, at temperatures of 85 to 95 deg. C. Some large wound rotors and armatures, and some stators of large motors, required up to 50 hours in the ovens. Nearly all temporary ovens were equipped with fixed or portable thermostats. The problem was to keep a close check against harmful "hot spots" in crowded ovens, with improper circulation.

Many shops would not risk water-soaked controller panels in their ovens, but placed them on top, where temperatures were lower. Only coils that had been removed from their panels were baked inside the ovens. Large machines were dried in 72 to 96 hours by providing separate enclosures and

[Continued on page 200]

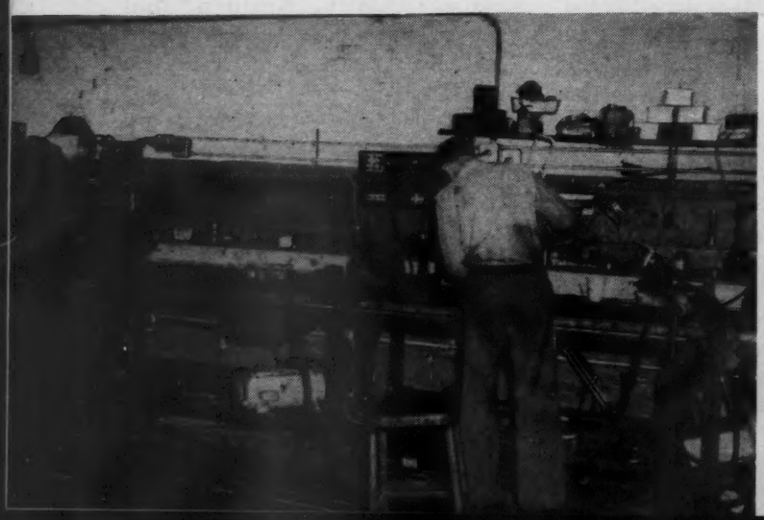
Joe Heller (left) inspects a new logarithmic chart which Sam Heller, his brother, has developed to speed up motor winding calculations. Joe and Sam Heller own and operate the Consolidated Electric Motor Company of New York City.

Service for ELECTRICAL SERVICEMEN

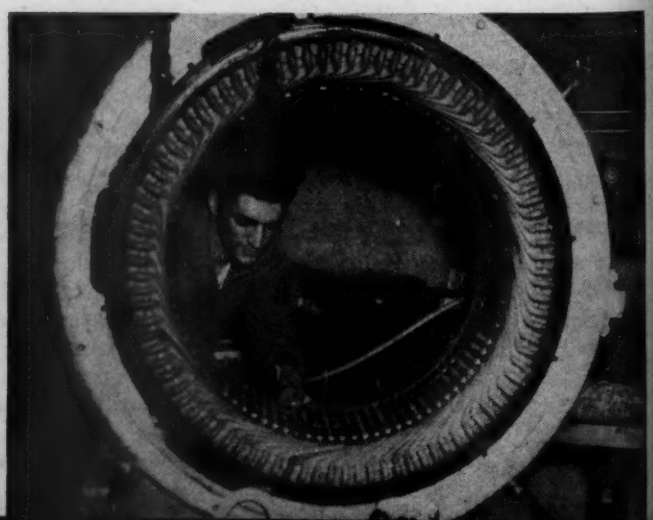
Consolidated Electric Motor Company, New York City, specializes in electrical repair work exclusively for electrical contractors, motor service shops and motor dealers, necessitating maximum efficiency in production and management.

A commutator is heated by Leno Bonomi preparatory for tightening. Test panel on wall has 120/208 volt a-c, and 110/220 volt d-c with series resistors for testing with limited current.

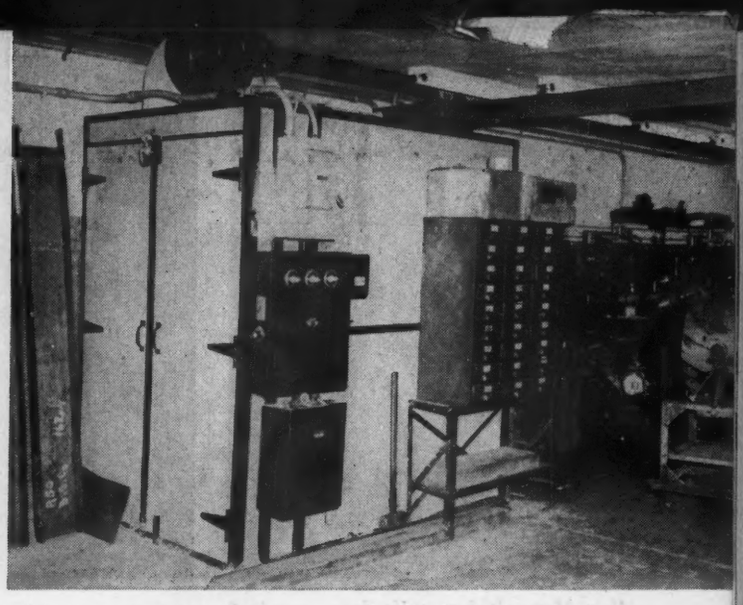
Harold Caffrey (left) and foreman Sidney Rosenfeld work on small motors, 5 hp. and smaller, at one of the work benches in the small motor department. Note electric test panels on wall, also gas and compressed air hose, available for each workman at bench.



Frank Bonetti hooks up a 100 kw., 2400 volt, 3 phase generator, immediately after testing with high voltage to ground. The h-v transformer can be seen on the work bench in the background through the stator. Complete test facilities are provided at each work bench.



Main service entrance and distribution panels are on wall adjoining receiving department entrance. Capacity is 100 amp., at 120/208 volts, 3 phase, 4 wire a-c service, and 200 amps., 220 volt, 3 wire d-c service. Overhead hoist with block and tackle is for loading and unloading heavy motors.



This large 30 kw. electric oven is fully automatic, with timer. A ¾-hp. motor operates blower (top of oven) which continually circulates the hot air, increasing oven efficiency and preventing hot spots within oven. When blower motor stops, current is automatically cut off in oven.

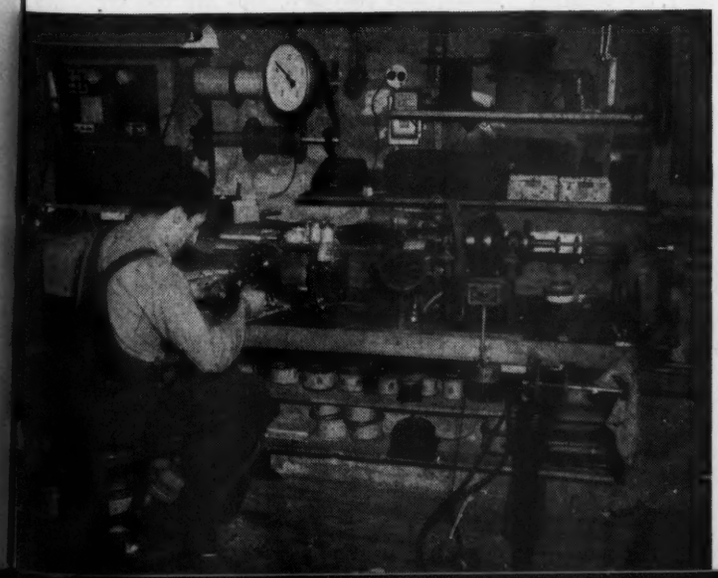
MOTOR repair shop men know that their business usually increases as the nation's economic condition declines. Thus, it is not unusual that the Consolidated Electric Motor Company, New York City, was depression-born. It opened for business on March 4, 1933, same day that Franklin D. Roosevelt was inaugurated for his first term as President, at the height of the depression in the early 30's. Sam and Joe Heller, owners, recognized the need for an efficient and low cost electrical maintenance and repair service, exclusively for the electrical trade, to help the electrical servicemen keep the old motors and electrical equipment of industry in repair when capital investment in new equipment could not be justified.

From that beginning 15 years ago, the Consolidated Electric Motor Company has grown. The Heller brothers work on the premise that their success lies in the success of their customers. They recognize that their operation must be highly efficient, so that services are sufficiently low in cost to permit their customers to make a fair profit, which in turn will insure the success of their own customers. As a result, Consolidated's plant is production-streamlined throughout. It is also equipped with all standard and special machines, hand and power tools, and other necessary equipment required to save time and lost motion.

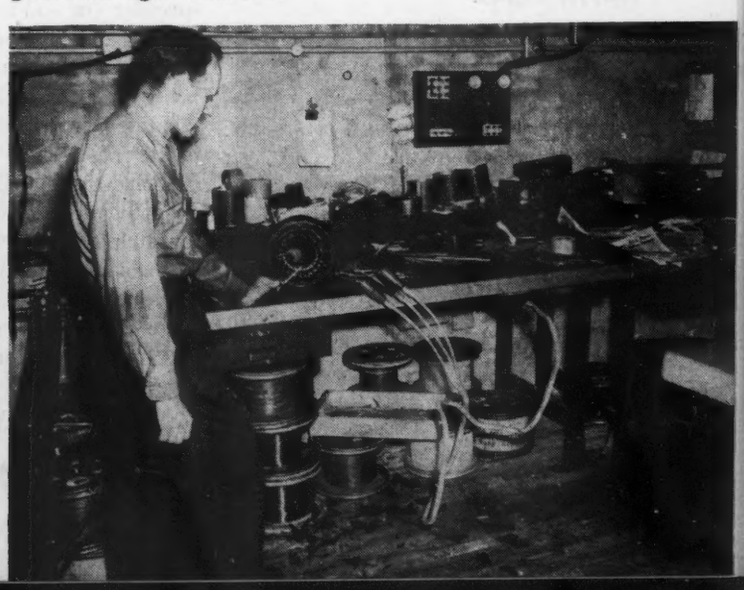
Formerly located at 170 Center Street, Consolidated outgrew the space available at that location. Early in September, 1947, they moved to new and larger quarters at 97 Lafayette Street, their present location, containing approximately 6500 square feet of floor space. The new plant is L-shaped and two stories high. It faces on "no parking" Lafayette Street and Walker Street. Customers are thereby assured of easy access to the receiving department on Lafayette Street at all times, where they can back their trucks into the building and off the street for loading and unloading.

Electric Service—The plant is serviced with both alternating and direct current service, at two separate service entrance points. On the Lafayette Street side is a 1000 amp., 3-phase, 4-wire, 120/208-volt, 60 cycle a-c service, and a 200 amp., 220-volt, 3-wire d-c service. Another service entrance on the Walker Street side provides 400 amp., 3-phase, 4-wire, 120/208-volt 60 cycle a-c service. This assures ample power and flexibility for all machinery and test purposes, and a safety factor

Work bench in magnet coil department, with Dominick Bruno taking apart a-c contactor preparatory to converting from 110 volt 60 cycle to 550 volt 50 cycle (for export). High speed winder on right (note speed indicator scale) runs at speeds from 1800 to 9000 rpm.



Test facilities include 3-phase, shown in use by James Young, testing a winding for polarity and shorts. A metal ring (end of pointer) or steel ball is placed in stator and current turned on. If the ring or ball rotates smoothly, a good winding is indicated.



Alex Moroz takes coils from small 9 kw. electric oven in coil winding department after baking operation. This Gruenberg Electric Co. oven is fully automatic.

Angelo Cassetta, turning a commutator for a small motor armature, is using a quick-change type Logan lathe. The machine shop is also equipped with a 42-inch swing McCabe lathe.

Cuffing machine, designed by owner Sam Heller and built in the plant, is used by Al Daniels to cuff paper for slots. The cuff strengthens the paper and makes it easier to install.

Small winding department, with Jimmy Bellotti using #33 wire on a universal armature, taken from a high speed engraving unit. Work is done in this department using wire as small as #46.

William Bellotti, foreman, tapes coil for a 30 hp., 50 rpm. slip ring motor. The motor was previously 25 cycle, and is being rewound for 50 cycle, 340 volt, for export.

against power failure in either main service. Switching has been arranged so that all current is turned off each night when the plant closes, except for power to electric furnaces, electric clocks, night lighting and electric neon sign circuits. This safety precaution was made in case any employee should fail to disconnect any test circuit or other load circuit which might be hazardous. Electric furnaces are automatically controlled by time clocks.

Facilities—The plant is departmentalized for maximum efficiency in handling the various types of repair jobs received. All heavy work is done on the ground floor, and light work, such as coil winding, etc., including office and engineering department work is done on the second floor. Included in the facilities on the ground floor is the small motor and welding departments, large electric oven, generator room, stripping department and a large machine shop. A smaller electric oven is located on the second floor in the coil winding department, where is also located the d-c and a-c magnet coil department, large coil winder and spreader (or coil former), a-c winding heads, band saw, coil taping machines, paper cuffing machine and work benches for single and three-phase windings, and other similar equipment.

Included in the machine shop and stripping areas are complete facilities for stripping, a 10-inch, 16-inch and 42-inch lathe, milling machine, grinders, punch presses, band saws, etc. A large exhauster is used to draw fumes and smoke from the welding and stripping departments.

A total of 25 individual test panels are provided over work benches, giving workers complete testing facilities where most needed. Each test panel has 110/220 volt d-c service and resistors for variable voltage, and 120/208 volt a-c 60 cycle service. Step-up transformers are used for higher voltages, and m-g sets provide other frequencies when needed. At each test panel location gas and compressed air are also provided.

A complete set of tools of types required is furnished to each employee, and, when needed, special tools are made or purchased which will simplify or speed up the work. New tools are always available whenever the old ones show excessive wear. The Heller brothers consider good tools, kept in good order, a sound investment.

Many of the machines and time saving tools have been designed by Sam Heller and made by the men right in the shop. Suggestions or improvements recommended by employees are encouraged, and are usually incorporated in new machines, tools, methods or management procedures.

Type Work Done—No job is too small, and very few jobs are too big, for this plant to handle. General motor repair work, both mechanical and electrical, accounts for a large part of the firm's business. Considerable "change over" winding work is done, especially on motors destined for export. A typical example is one job for export to Argentina in which a 350 hp., 500 rpm., 2200 volt, 25 cycle slip ring, bar weld motor was rewound (rotor and stator) for 500 rpm., 380 volt, 50 cycles, constituting a complete change in rating and characteristics

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Industrial Signaling and Communication Systems

By
A. A. Schuhler

Plant protection, supervision, organization and efficiency can be effectively aided by carefully selected and properly installed signal and communication systems.

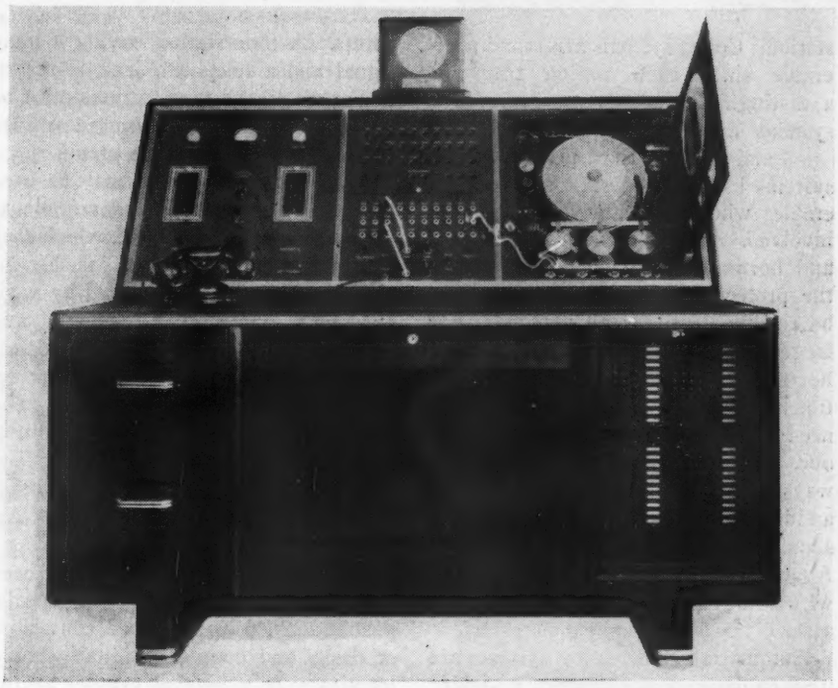


FIG. 1—Protective signaling and communication can be combined and centralized at one point for effective supervision. The board above combines watchman supervisors, center, fire alarm, left and program, right.

INDUSTRIAL plants offer opportunities for the application of the greatest variety of signaling and communication systems. Generally the requirements may be divided into three groups, (1) Protective signaling, (2) Supervision of industrial operations, (3) Organization of personnel efficiency aids.

Protective signaling may be applied to fire prevention, its control and the protection of property. Systems of this type are manual fire alarm, automatic fire detection, watchman's supervision, burglar and hold-up alarms, sprinkler alarms, smoke detection, door alarms and transformer alarms.

Supervision of industrial operations may be applied to manufacturing. Processes may be supervised so that any change or occurrence which becomes physically perceptible may be made known. It provides automatic advance warning of abnormal or dangerous conditions, and minimizes interruptions in the continuity of processes. Systems of this type are liquid level indicators, pressure indicators, temperature indicators, flow indicators, control valve and electric current control.

Organization or personnel efficiency may be applied to persons in the employ of the plant whether they are in the office, sales department, factory, storeroom, or in the receiving and shipping departments. Systems in this class are intercommunicating telephones, sound amplification, paging, clocks and program, conveyor signals, dispatching signals, loading and stockroom signals.

The following protection signaling systems require individual control equipment but may be interconnected and combined at one point to be supervised by the plant superintendent or the guard personnel. A typical example of this centralization is shown in Figure 1 wherein several systems terminate in a desk. The left hand panel on the turret is for the fire alarm, the center panel is for the watchman's supervision, the right hand panel is for the program clock, the lower right hand compartment is for the program bell cross-connecting panel.

Manual fire alarm systems should be of the closed-circuit supervised type. City and State ordinances should be checked regarding requirements. Generally non-coded systems are limited to small plants, since they only transmit a general alarm and do not indicate the location of the operated

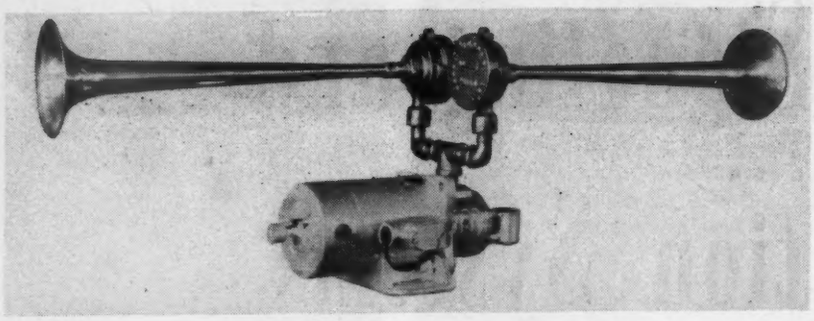


FIG. 2—Noisy surroundings must be effectively pierced with distinctive signals. The air horn above is typical of such specialized industrial equipment.

station. Coded systems are found preferable since each station transmits a distinguishable signal. Plain code systems are generally acceptable for small and medium sized plants. Group systems using coded stations are preferable where several buildings are involved. Audible signals such as bells and horns are distributed throughout the protected areas so that they may be readily heard by all persons. For large open areas use sirens or air horns as shown in Figure 2. Stations must be spaced so that no one need walk more than 100 feet to reach one. They must be located near stairways and other paths of escape. An audible signal such as a small bell should be located in the guard room. A punch recorder and take-up reel with time stamp is also a valuable asset.

Automatic fire detection systems are used to give an alarm when a sudden or quick rise in temperature occurs or when the temperature rises to a predetermined degree of heat. They may be used in large or small areas and also in ducts. They may be interconnected with a manual fire alarm system by means of electrically tripped transmitters. Those mounted in ducts may be arranged to disconnect the motor-driven blowers to prevent further spread of the hazard. They may also be used to close the duct dampers to isolate sections of the building.

Watchman's supervisory systems should be of a type which will require the watchmen on the various tours to produce a record in superintendents' or chief guards' quarters at the start and the finish of each tour. It should also contain provisions for the calls to be made to each station and in sequence. If so desired extra features may be included such as a delinquency indicator which will signal the chief guard when a guard is delayed in arriving at a station, or a telephone may be added so that communication may be had between headquarters and the outlying points. A tour station having a lamp signal and a telephone jack is shown in Figure 3. All tour stations must be located at such remote points to insure complete coverage of the premises.

Burglar alarm systems may be used to protect all doors, windows, elevator openings, skylights, etc. which may be readily accessible by a possible intruder. This is accomplished by various types of spring contacts and switches. On the interior, photoelectric equipment may be used to protect stockrooms, toolrooms, filerooms, and loading platforms. Safes and cabinets may be protected by special electrified enclosures or capacity alarms. All signals should terminate in a control cabinet at the chief guard's quarters.

Hold-up alarm systems may be used in the disbursing office using special pushbuttons, foot and knee contactors at desks and counters, signals should terminate in a control cabinet at the chief guard's office with extension signals to possible points of apprehension.

Sprinkler alarm systems are used to signal when sprinkler heads open, when waterflow valves operate in either dry or wet systems, when post indicator valves operate. A supervisory control panel should be provided to indicate the condition of each circuit. A code may be transmitted on the fire alarm bells by the inclusion of an electrically tripped transmitter.

Smoke detectors are used to detect smoke in ventilating, air-conditioning and dust collecting ducts. This is accomplished by means of photoelectric tube systems wherein the light source directs a beam to a photoelectric tube across the interior of the ducts. The photoelectric equipment may be adjusted to operate when the smoke in the duct reaches a predetermined density. Relays are a part of this equipment and transmit the signal to annunciators at the guards' quarters and may also be transmitted on the fire alarm signals.

Door alarms are used to signal the guard room when certain restricted areas have been entered or vacated by individuals. The doors are provided with contacts or switches which operate lamps or drops in an annunciator. A lamp type unit is shown in Figure 4. These systems are generally of the closed circuit type. Relay panels are used to supervise the equipment. An audible signal is provided at the supervisory location with isolating switches for each circuit. In addition it is also desirable to operate a large alarm bell adjacent to each guarded door.

Transformer alarm systems are used to designate the dangerous increase in the temperature and pressure in oil cooled transformers. Pressure and temperature switches are provided for this purpose and are inserted into the transformers. These switches are connected to supervisory control cabinets located in the engineer's office or the guard room. Provision may also be made for the release of CO_2 tanks in transformer vaults.

The following industrial operation applications may be used with individual system control panels, or may be interconnected with other systems direct or by the use of electrically tripped transmitters. They may terminate at some point where they will receive careful supervision, such as the superintendent's office.

Liquid level indicator systems supervise the high and the low levels of the liquid contents of tanks, cisterns, reservoirs, etc. These units are provided with contacts and the associated actuating switch and float for proper operation.

Pressure indicator systems supervise all measurable forms of pressure such as air, oil, water and steam. These units are provided with actuating

FIG. 3—Watchman's station permits convenient and quick reporting from any part of the tour.

switches which are operated by changes in pressure. A signal is given to indicate high, low or normal and abnormal conditions.

Temperature indicator systems supervise the temperature of liquids. These units are provided with a thermometer with electrical contacts to actuate a switch, audible signal, annunciator drops or transmitter as desired. The unit detects high and low limits in temperatures.

Flow indicator systems supervise the flow of various liquids in pipes whether relatively small or rapid, or the start and the stopping of a flow. The unit consists chiefly of a built-in paddle which motion is transmitted to the electrical contacts.

Control valve systems supervise all types of devices. They transmit signals to show that a change has occurred from a normal position of a valve and subsequent restoration to normal.

Electric current control systems supervise the electrical power. They transmit signals to show when electric current is turned on and off. A permanent record of these activities may be made on a chart. The control is usually accomplished by means of relays and magnetic switches, and arranged for either open or closed circuit applications as required.

The following organization or personnel systems are usually used throughout a plant but as complete systems within themselves. They are seldom interconnected with other equipment except to consolidate equipment used by the operators.

Intercommunicating telephone systems may be provided in various forms, and the selection should be based upon the practical requirements. There are cases in small plants where a two station or pair telephones are desired to converse between two points. For larger installations up to about ten stations, where only one conversation is found necessary at one time, the common-talking selective ringing system may be used. In systems up to about 25 stations, where all instruments may be used at one time, the selective talking-selective ringing system should be used. Where it is desired to have a small number of outlying telephones supervised from one location, and only one pair of conversations are desired at one time, a master common-talking system is frequently found satisfactory. For large systems switchboard systems should be used where it is desired to have supervised control from one location. Large systems requiring selective control from all points should be of the automatic relay or machine switching type.

Sound amplification systems may be used throughout a plant for paging, transmitting radio programs, recordings, announcements and entertainment derived from centralized systems. A typical unit of this type is shown in Figure 5, in which all controls are located at one point. Loudspeakers are distributed throughout the plant with all wiring terminating at the control panels.

Paging systems are used to call and locate individuals, for answering telephones, attending meetings etc. In general, these systems may be either of the audible or silent type, however, in the majority of cases the former is preferable. One form of audible system consists of a code transmitter with audible signals such as bells or horns with the associated control equipment. Another may be a sound system consisting of a microphone, a number of loudspeakers and the associated amplifier equipment. The silent system used in laboratories and offices consists of a keyboard, a number of lamp annunciators and the necessary control equipment.

Clocks and program equipment is used for indicating the time of the day and operating bells or horns at predetermined times such as starting and stopping time, rest periods, etc.

Conveyor signal systems are used to indicate to various locations when the conveyor is to operate, when it is to stop and when an emergency exists. The system usually consists of bells, horns and pushbuttons. In addition photoelectric units may be installed at various points along the route with counters to designate the passing of certain articles along the line.

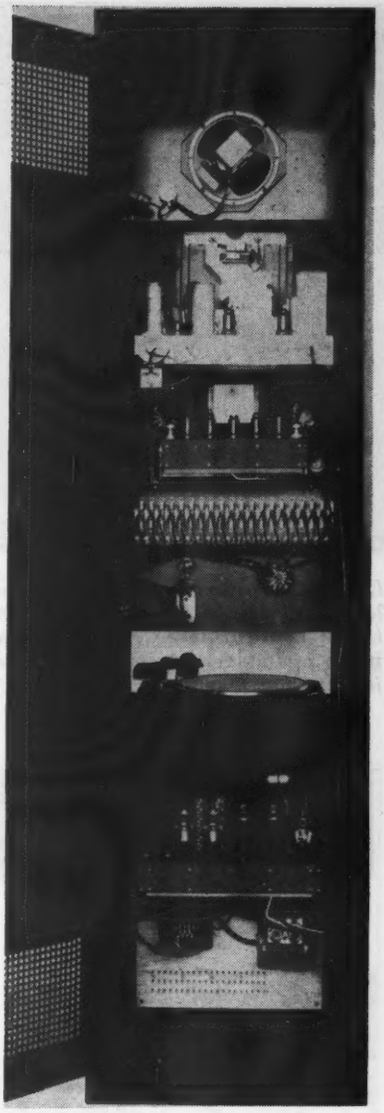


FIG. 5—Most extensive of modern industrial signaling and communication apparatus are the sound systems providing paging, industrial music and announcements.

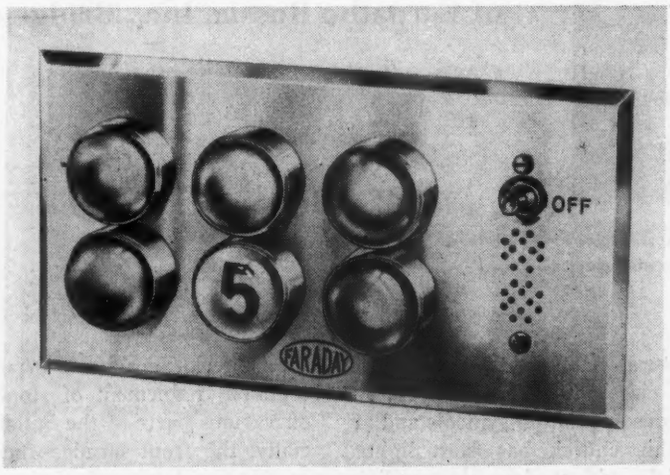
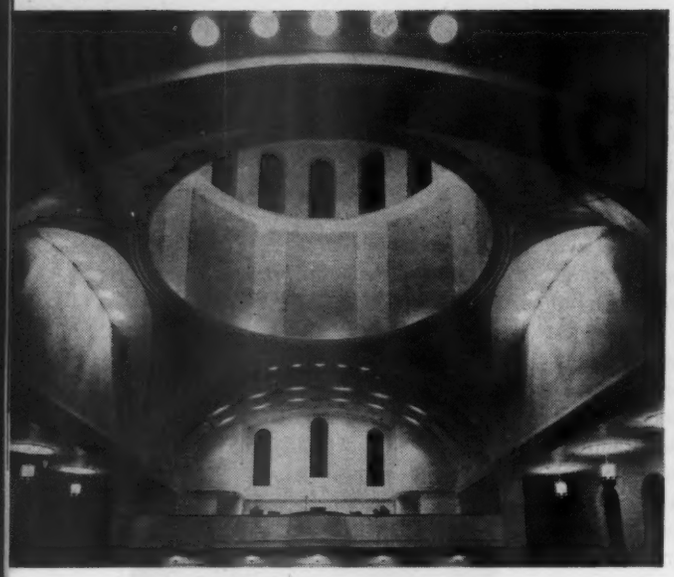
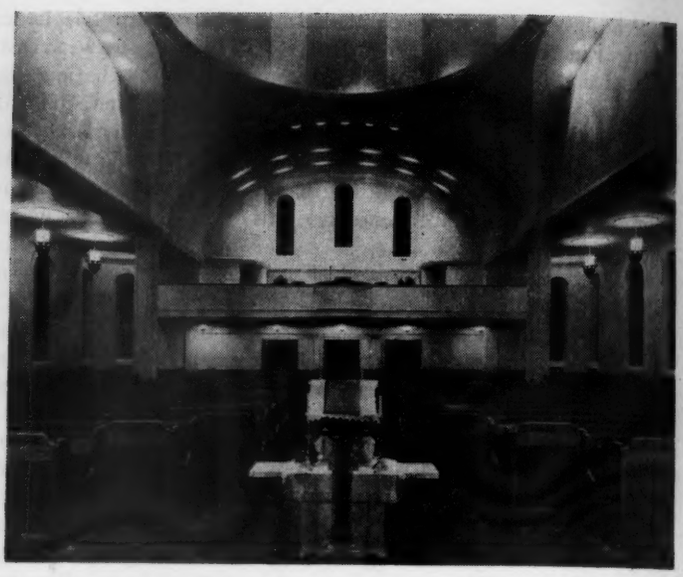


FIG. 4—Lamp annunciators can be operated by a variety of switching devices such as door alarms. On protective equipment they are usually closed circuit types with audible warning signals.



Central dome provides indirect light in nave from lamps in cove at base of dome. Only one-third of lamps (one of three circuits) were lighted when photo was made. Recessed lens units in arched ceiling provide reading light in nave.



Choir gallery at rear of church is illuminated brightly for 100-voice male Russian choir by 20 recessed 150 watt R-40 lamps, shielded from nave by furrows in plaster. Note special lantern luminaires over sides of nave, and special shallow units under choir gallery.

Planned Church Lighting

The Carpatho Russian Greek Catholic church in Bridgeport, Conn. is Byzantine design. Floodlights accent design features by night.

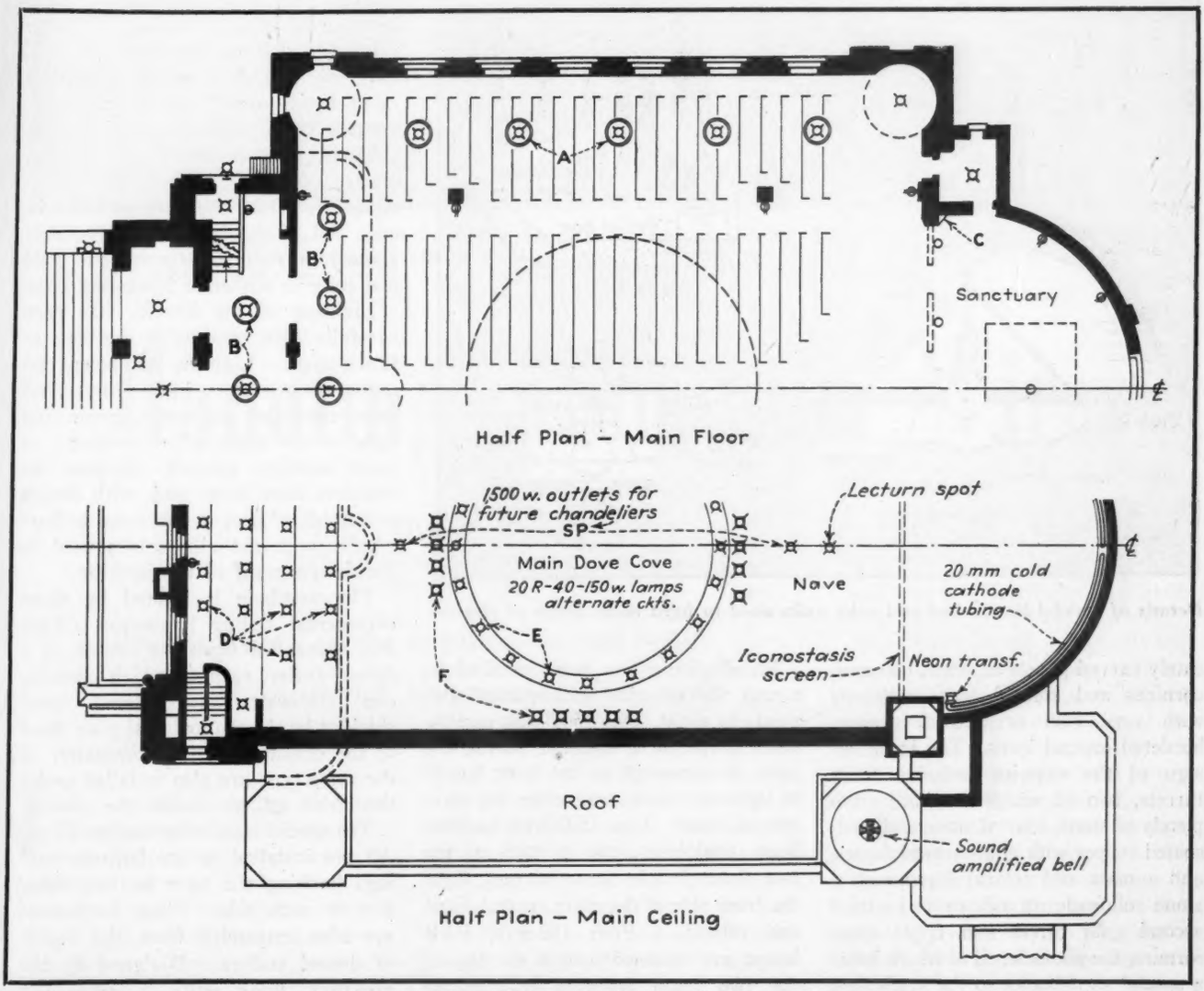
Architect and engineer skillfully combine modern light sources and Byzantine architecture in new church of the American Sons & Daughters of Carpatho Russia, Inc., Bridgeport, Conn.

By Berlon C. Cooper

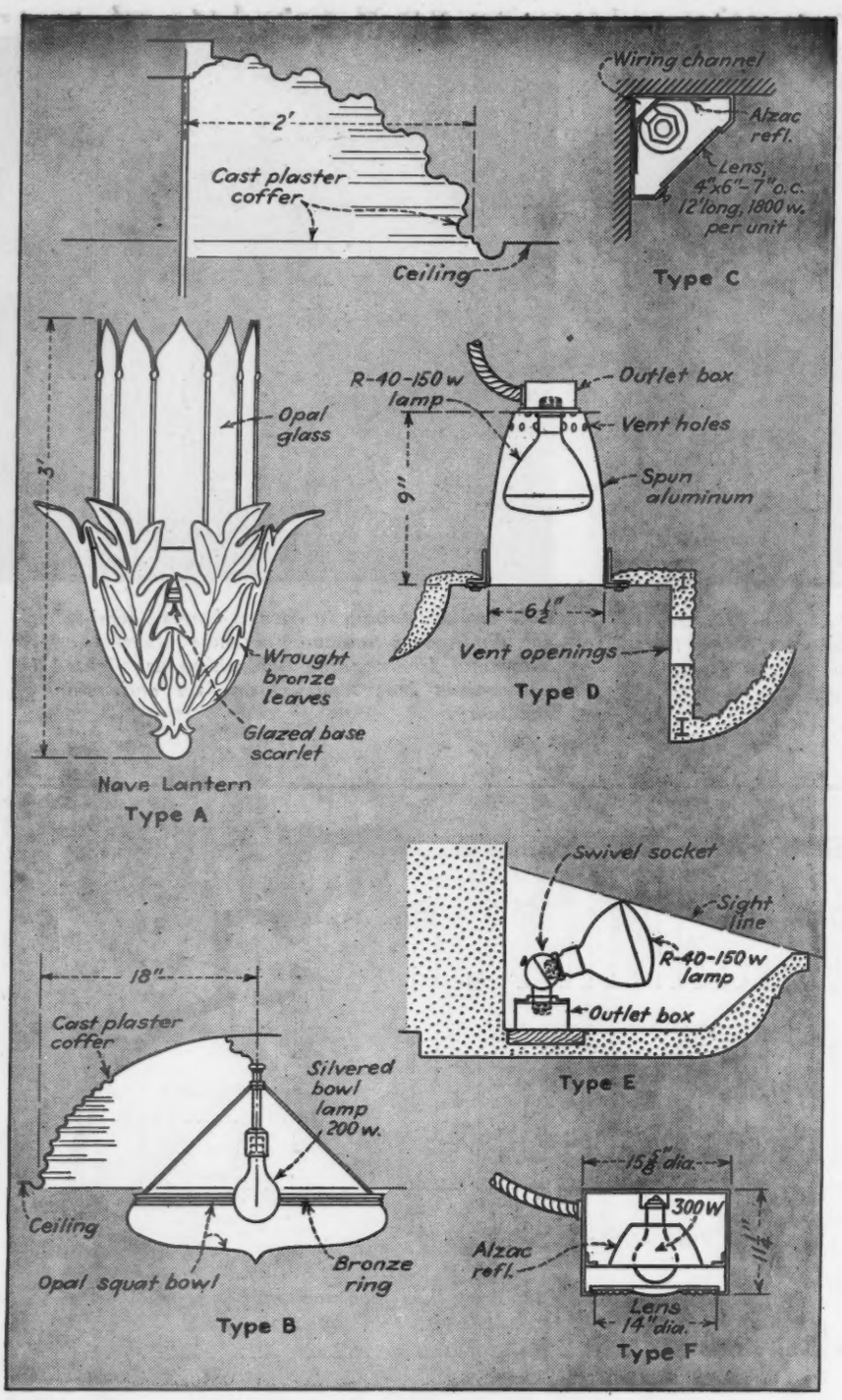
THE new Carpatho Russian Greek Catholic church in Bridgeport, Conn., recently completed, exemplifies *planned* church lighting. It illustrates effectively how artificial light can be made to form a part of the artistic design and subtly accent the architectural features. Of authentic modern classic Byzantine design, including ornamentation symbols and art work, this church has been lighted successfully with modern postwar light sources and lighting equipment for both utilitarian and artistic purposes. The exterior design incorporates exceptional refinement of stone carving on various parts of the building, especially, the front facade. Incorporated in this facade are all of the art crafts required for completeness in Byzantine design, such as mosaic panels, deli-

Church interior looking toward altar and sanctuary. Screen of Iconostasis frames the front arch of the sanctuary, and is illuminated by recessed units in arch over nave. Single spotlight is focussed on the lecturn. Mikes for public address system are located at lecturn and in choir gallery.

Cold cathode tubing in cove at base of semi-spherical dome over sanctuary creates ethereal effect. Altar and free-standing baldachino are lighted by proscenium lens troughs, one on each side of sanctuary.



Half plan, main floor (top) and main ceiling (bottom), showing location and types of lighting units and equipment. Public address and other electrical features are not shown on these plans.



Details of special luminaires and cove units used to light main areas of church.

cately carved panels in stone, columns, cornices and stained glass windows with very rich ornamental designs bordered around icons. The basic design of the exterior includes seven turrets, two of which are built completely of stone, four of stone and lead-coated copper with gold-crossed domes, and a main and central dome with a stone collonade rotunda capped with a second gold turret and triple cross forming the pinnacle, all of which bears a special significance to the symbolism of the church.

Floodlighting has been installed to accent the exterior architectural elements by night. One 1500-watt narrow beam projector is installed behind the apex of stonework on the front facade to light the triple cross over the main central dome. Two 1500-watt medium beam projectors, one in each of the two front facade stone turrets, light the front side of the main central dome and rotunda. Four 150-watt PAR lamps are recessed behind the top of the two main entrance columns to light the interior of the portico, which also silhouettes the columns against the lighted interior. Flush 60-watt units are installed in the inside walls of abutments at each end of the entrance steps, which project light out over the steps. The entire front of the building is also illuminated softly by two 500-watt enclosed floodlights installed on the church lawn, one on either side of the entrance and approximately 30 feet from the building.

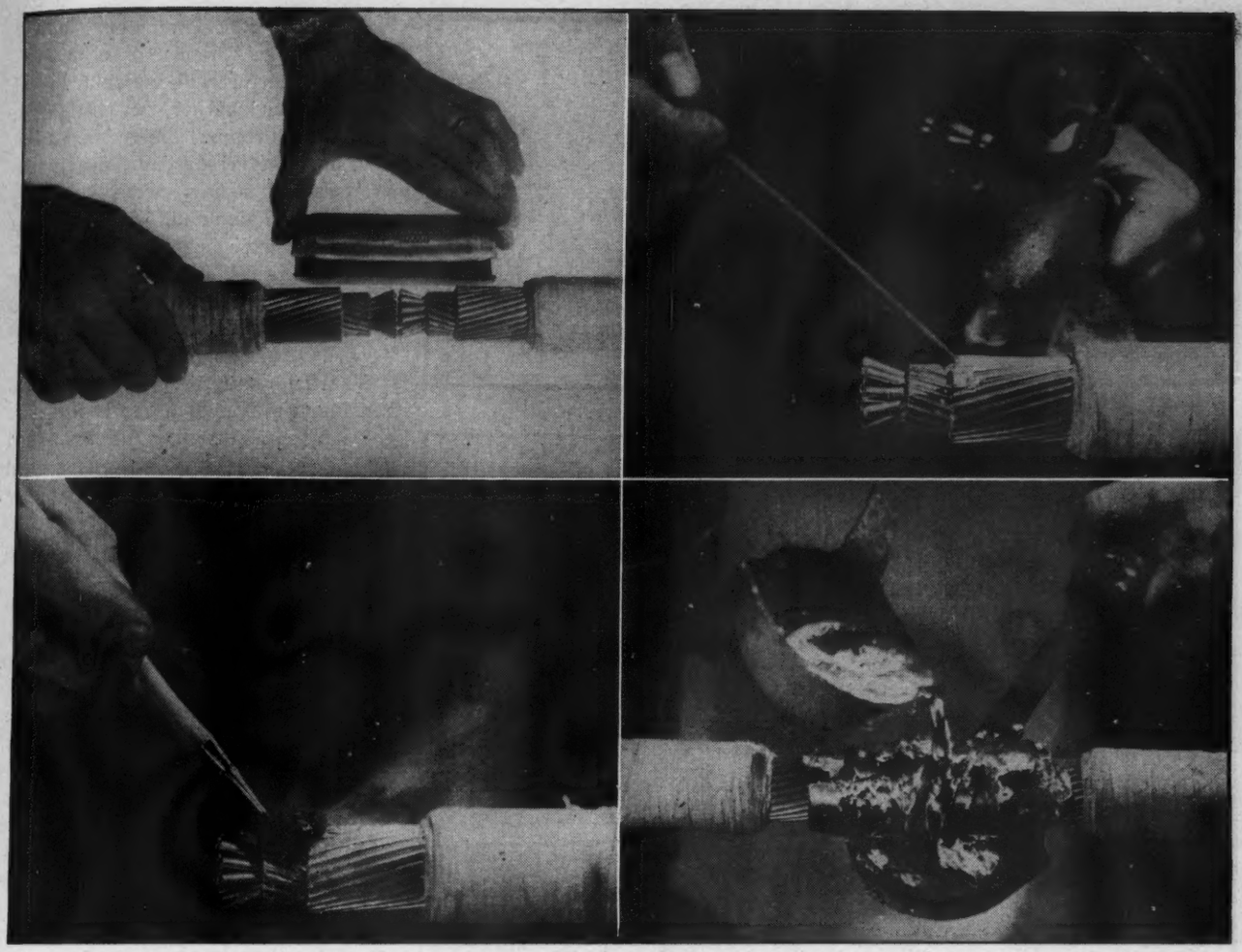
The interior of the church is also of Byzantine design. The first floor plan of the church proper includes an entrance portico, vestibule, a nave and balcony, central dome and vaulted ceiling, an Iconostasis, a domed sanctuary with free-standing baldachino, and a central altar directly in back of the screen of Iconostasis and under the baldachino. Adjacent to the sanctuary are confessionals, a sacristy, vestment room and rear exits. The interior is 75 feet square, with four ornamental columns supporting a huge central dome with a rotunda of stained glass windows. On each side of the nave are eight stained glass windows which incorporate icons of various Christian subjects and Byzantine designs of brilliant color. The screen of Iconostasis is of hand carved wood, and incorporates 50 oil painted icons of various subjects, such as the Blessed Virgin, Christ, Apostles, Evangelists, Disciples, Prophets, the various holidays, etc. All of the icons are elaborately framed in rich polychrome and gold leaf color in authentic Byzantine style.

Lighting of the interior has been carefully integrated with the Byzantine design. Lighting equipment incorporating modern light sources has been concealed generally, projecting light to the areas where needed. In some locations specially designed luminaires have been used, with design and finish of proper character to harmonize with the rich colors used in the design motif of the interior.

The vestibule is lighted by three ornamental ceiling luminaires (Type B), suspended from the center of a domed coffer, each of which contains one 200-watt bowl-silvered lamp shielded by the shallow opal glass bowl of the luminaire. Five luminaires of the same type are also installed under the choir gallery inside the church.

Ten special lantern luminaires (Type A) are installed on the buttress ceilings flanking the nave on two sides, five on each side. These luminaires are also suspended from the center of domed coffers. Designed by the architect, these units incorporate a

[Continued on page 202]



Soldered splice, 1) outer layers are stepped and center wires fanned; 2) conductor heated until solder stick starts to melt; 3) flux applied thoroughly to all strands and worked into ends; 4) after "tinning", the assembly is tightened and solder ladled into the splice.

Handling Aluminum Wires

By C. W. Ange and E. E. McIlveen

The Okonite Company
Passaic, N. J.

Practical data on the application and installation of insulated aluminum wires and cables in buildings.

FOR the past half century, the use of aluminum as a bare conductor has been universally recognized in the electrical industry. Today, there are over one and one-half million miles of ACSR high tension lines and innumerable bus installations in operation in this country giving excellent service. But only recently has aluminum been used as an insulated conductor.

In general, because of conductivity differences, aluminum conductors must either be of larger diameter or operate at higher temperatures than copper. Where insulated conductors are concerned, larger diameters require greater volumes of insulation for the same wall thicknesses.

For similar conductor diameters, where higher operating temperatures are employed, more expensive heat resisting insulations are necessary. These are factors which tend to increase cost and have in the past limited the use of aluminum in this field.

Now, however, the price differential between aluminum and copper is such that these added expenses are offset by the substantially lower price of aluminum.

Accordingly, some pertinent facts on the application of insulated aluminum should be of interest to engineers and contractors, so that it may be considered seriously, not as a substitute for insulated copper, but rather as a logical alternate which can stand on its own both economically and technically.

The problem of the galvanic corrosion of aluminum has been given con-

TABLE I

BASIC ELECTRICAL PROPERTIES

Metal	Hard-Drawn E. C. Aluminum	Uncoated Annealed Copper
Resistivity, ohms per mil, foot @ 20°C.	17.002	10.371
Resistivity, ohms per mil, foot @ 25°C.	17.345	10.575
Temp. Coeff. of Resistance from 20°C., per °C	0.00403	0.00393
Temp. Coeff. of Resistance from 25°C., per °C.	0.00395	0.00385

TABLE II

EQUIVALENT ALUMINUM AND COPPER CONDUCTORS

Basis: Similar Resistance

Hard Drawn Aluminum				Tinned Annealed Copper	
	D-C Resistance, Ohms-1000 ft.				D-C Resistance Ohms-1000 ft.
Size AWG or MCM	Solid Wire at 25°C	Class "B" Strand at 25°C	Class "B" Strand at 75°C	Size AWG or MCM	Class "B" Strand at 75°C
16	6.72	6.85	8.20	18	8.407
14	4.22	4.31	5.16	16	5.283
12	2.66	2.71	3.25	14	3.208
10	1.67	1.70	2.04	12	2.051
9	1.33	1.35	1.62	—	—
8	1.05	1.07	1.28	10	1.288
6	.661	.674	.807	8	.810
4	.416	.424	.508	6	.509
3	.330	.336	.403	—	—
2	.261	.266	.319	4	.321
1	.207	.211	.253	3	.254
1/0	.164	.168	.201	2	.202
2/0	.130	.133	.159	1	.160
3/0	.103	.105	.126	1/0	.126
4/0	.0820	.0836	.101	2/0	.100
250,000		.0708	.0847	3/0	.0797
300,000		.0590	.0706	—	—
350,000		.0506	.0605	4/0	.0626
400,000		.0442	.0530	250,000	.0535
450,000		.0393	.0471	—	—
500,000		.0354	.0424	300,000	.0446
550,000		.0322	.0385	350,000	.0382
600,000		.0295	.0353	—	—
650,000		.0272	.0326	400,000	.0332
700,000		.0253	.0303	450,000	.0295
750,000		.0236	.0283	—	—
800,000		.0221	.0265	500,000	.0265
900,000		.0197	.0235	550,000	.0243
1,000,000		.0177	.0212	600,000	.0223
—		—	—	650,000	.0204
—		—	—	700,000	.0190
—		—	—	750,000	.0176
1,250,000		.0142	.0169	800,000	.0166
1,500,000		.0118	.0141	900,000	.0147
1,750,000		.0101	.0121	1,000,000	.0132
2,000,000		.00885	.0106	1,250,000	.0106

siderable thought. Aluminum is anodic to copper and where used as an electrical conductor will undoubtedly, at one time or another, be brought in contact with copper. There is no doubt that under adverse conditions, in the presence of strong electrolyte; corrosion of the aluminum will take place. This is a fact which should be recognized and proper precaution taken for prevention even though service records indicate that galvanic corrosion in service is exceptional.

Thorough waterproofing of exposed aluminum to copper joints is probably the most practical preventive method which can be used. The use of a good rubber tape or waterproof weather resistant paint applied with care to completely cover both metals, gives excellent results.

One of the remarkable features of aluminum when used under rubber insulations is its resistance to corrosion due to sulfur.

Aluminum is not corroded under rubber compounds, nor will it affect, in any way, the life of rubber insulations.

Considering the excellent service record of bare ACSR conductors and aluminum buses in practically all conditions, there can be no doubt of this metal operating satisfactorily in an insulated cable where it is for the most part well protected and unlikely to be attacked before the insulation itself has been destroyed.

Electrical Properties

The electrical conductivity of E. C. grade hard-drawn aluminum wire is not less than 61.0 percent of the I.A.-C.S. copper standard. The basic resistances and correction factors are presented in Table I. The indicated temperature of zero resistance is minus 228.1 degrees Centigrade.

By equating the resistivities, it can be shown that the direct current resistance of aluminum at 25° C. is exactly 1.640 times that of bare annealed copper. It is about 1.59 times that of tinned or alloy coated copper. Further, the circular mil size of aluminum conductors which have the same d-c resistance as a given copper conductor may be found by multiplying the copper size by these same factors. Table II is arranged to show, by reading horizontally, the aluminum and copper sizes with similar direct current resistances. Since there would be complications with fittings and joints, for one thing, if odd sizes were used as would be the case with the conductor

sizes obtained from the factors, the circular mils are rounded out to the nearest standard size. Where no standard equivalent could be found, the space was left blank. The degree of difference can be readily seen in this tabulation.

Splicing and Terminating

Acceptance of aluminum as a conductor material in insulated wire and cable, aside from economic factors, has, in the past, been retarded by difficulties involved in splicing and terminating. Lacking economic incentive, technical work on this problem has been slow.

There can now be no doubt that aluminum may be safely and permanently installed without the slightest apprehension provided connections and splices are properly made. Procedures used are no more difficult or troublesome than with copper after experience has been gained.

The difficulties which have been encountered in splicing and terminating are due primarily to the inherent oxide film which forms rapidly on all aluminum surfaces when exposed to the air. This oxide film is an insulator which must be broken through or removed in order to form good low resistance connections. Further, air must be excluded by tight metal to metal contact and by the use of a good joint compound similar to No-Ox-Id A-Special or Alcoa No. 1 Joint Compound.

When connecting aluminum with fittings of dissimilar metals such as copper or bronze, the fittings should be plated with a heavy coating of zinc or cadmium or tin to avoid possible trouble from electrolytic corrosion. Aluminum is definitely anodic to copper and in the presence of an electrolyte, a tendency toward galvanic action is present. Plating fittings with zinc, cadmium or tin reduces dissimilarity and minimizes the objectionable condition. In exposed locations, junctions should be well covered with rubber tape to insure permanently satisfactory operation. This does not differ from best procedures in exposed copper to copper connections.

Soldering

Entirely satisfactory soldered connections can be made between or to aluminum using methods not too different from those normally employed in joining copper.

To successfully "tin" aluminum for good soldering, it is first necessary to completely destroy the tough surface oxide film. This can be accomplished by either abrading the surface under molten solder or by using a proper flux. then soldering.

Solders for the former method are usually high in zinc content and alloy readily with aluminum. They are of fairly high softening point, being completely fluid at around 350° C. (662° F.). The aluminum is prepared for soldering by thoroughly wire brushing. It is then heated to the required temperature with a torch. The solder, in the form of a stick, is rubbed firmly into the surface, destroying the oxide under the melting alloy and allowing "tinning" to take place. After this, standard procedures may be followed.

This method proves practical and gives excellent results where surfaces to be soldered are completely exposed. It is not practical where multi-strand cables are involved and each strand would have to be individually "tinned".

For general work, it is best to use a proper solder and flux whose application approaches more closely accepted methods.

Corrosive fluxes containing zinc chloride are not recommended since it is difficult to completely remove residues. Standard lead-tin solders are likewise not recommended since they do not alloy readily with aluminum, and are more susceptible to galvanic corrosion.

Alcoa No. 62 flux and XA-803 solder have been found to give very satisfactory results. The No. 62 flux is a non-corrosive material suitable for use only with solders that have good flow characteristics below 500° F. Temperatures in excess of 500° F. cause rapid deterioration of the flux with the formation of a brown or gray film which prevents smooth flow and adhesion of the solder. For temperatures up to 500° F., the flux has sufficient activity for practically all soldering jobs.

XA-803 solder has all the flow characteristics necessary for soldering with No. 62 flux. It approaches aluminum more closely in the electromotive series than standard lead-tin solders and alloys readily with that metal.

The secret of good soldering lies in proper fluxing. If a joint is fluxed at between 400 and 500° F. and care is taken not to decompose the flux, standard soldering procedures may subsequently be followed.

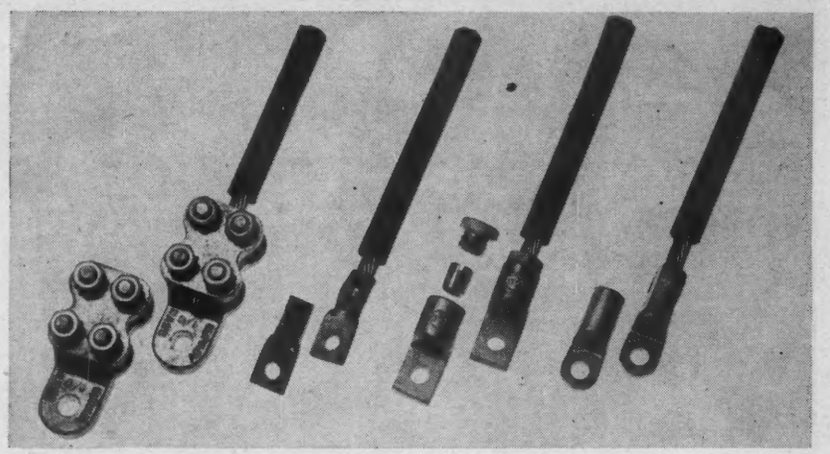
In small conductors, pig-tails or

[Continued on page 184]

TABLE III

SHORT CIRCUIT CURRENTS

Aluminum Conductor			Copper Conductor		
Condr. Size	CM	Current for 80°C. Rise in 15 Cy.	Condr. Size	CM	Current for 80°C. Rise in 15 Cy.
4	41740	3100	6	26250	2900
2/0	133100	9800	1/0	105500	12000
3/0	167800	12400	—	—	—
700	700000	52000	500	500000	55000
750	750000	55000	—	—	—



Pressure connectors, the types illustrated, are mechanical fittings which have been found suitable for use with aluminum conductors.

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

Practical Methods

Ed Woestendieck explains the method of adjusting steel bin shelves, labeling stock and maintaining truck inventories to new clerk in the service department of the Hampton Electric Company, Saint Louis, Mo.

Perpetual Stock For Mobile Units

INVENTORY

Efficiency is the keynote of the inventory system that keeps all trucks supplied with needed parts from the modern stockrooms of the Hampton Electric Company, Saint Louis, Mo. As reported by Ed Woestendieck, the Hampton Company maintains a fleet of eight panel trucks, four pickup trucks, a dispatch car and several executive vehicles. The panel trucks are used for normal repair work, residential wiring and the installation of lighting fixtures and electrical equipment in homes. The perpetual inventory carried by these units consists of some 400 items having a monetary value of approximately $750. Basically, these trucks carry sufficient material to completely wire a four-family apartment building. The four pickup trucks are utilized for commercial work, motor installations, power wiring and high-voltage work. The inventory in these vehicles varies according to the various assignments.

As each job is completed, special worksheets, carried in the cars, are filled in with the names of the electricians, the time consumed on the job and the parts and materials used from the basic truck stock. At the end of the day, the cars return to the main office. Time data is taken from the worksheets for payroll purposes, and truck stocks are replenished by replacing all items of equipment listed on the worksheets. This replenishing of stock is completed before drivers and electricians report the following morning so that no delays are created. In cases where working assignments involve other than standard inventory parts, tools, materials or work blanks, the required items are placed in the proper truck and the electrician is notified of the job characteristics, the location and the arranged time for performing the work.

The modern stockroom, from which all parts and tools are taken, is a 25-by-40-foot area in the new building of the Hampton Company. Sturdy steel uprights with adjustable shelving line the walls. Shelves can be raised, lowered or removed by moving supporting pins in the uprights and, in this way, each bin can be adjusted to accommodate the specific item and quantity of stock. Strip-type indicating tabs plainly label the items of stock and, with bins arranged to carry stock items in an alphabetical order, it is a simple procedure to train stockroom personnel in rapidly locating the desired items. Bins are normally seven tiers in height and are painted olive drab to improve the appearance of the area. Bulky electrical parts are accommodated by removing the desired number of shelves and special racks hold 20-foot lengths of conduit.

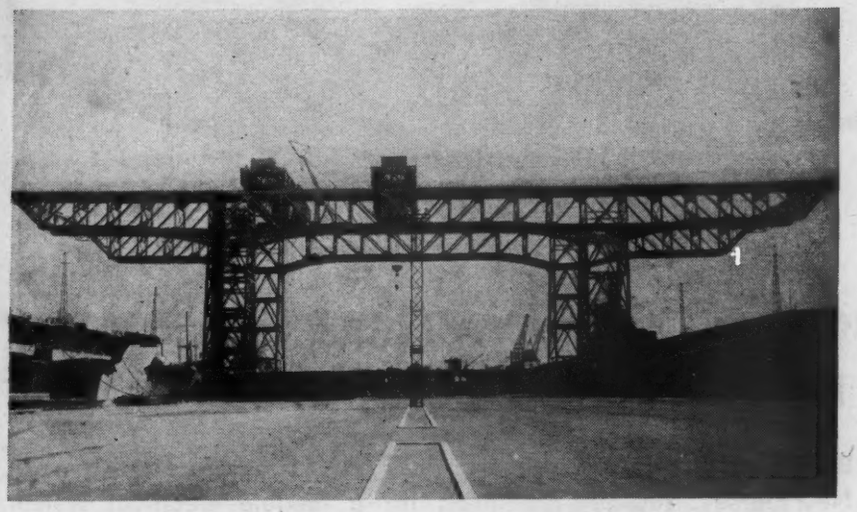
A driveway, capable of accommodating twelve trucks, runs through the new building and is protected from the weather by standard garage doors at either end. Trucks enter the building from the rear, stop opposite the stock room for parts, drive to the front of the building to check out with the dispatch officer, and then proceed out of the building in a one-way line of direction. The drive serves as a garage at night, eliminating the necessity for this added space. With the driveway indoors and protected, service between stockroom and trucks is faster and both personnel and materials are protected.

New Hoist Principle For Traveling Crane

HEAVY REPAIR

The world's largest overhead traveling crane, constructed to serve the San Francisco Naval Shipyard at Hunters Point, California, operates on a new principle of hoist control and is powered by 18 giant motors, the largest of which are rated at 135 hp. Two huge

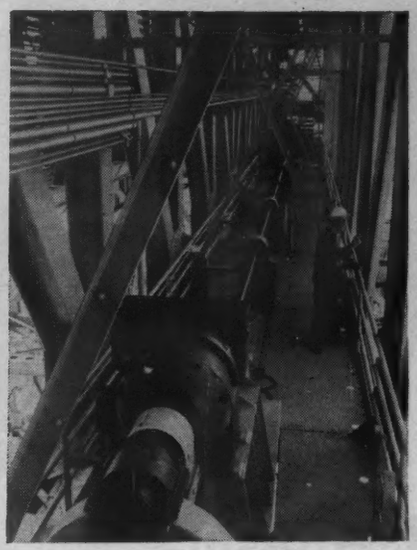
Over 1½ miles of collector rails are installed to conduct electric power to the cranes. When the two cranes are connected in tandem by an equalizer bar, the assembly can lift 500 short tons at 10 feet a minute. The cranes have a span of 142 feet.



Two cranes operate singly or in tandem along the 730-foot runway which spans a 405-foot pier and extends over the bay for a distance of 162 feet on each side. Over 10,000 short tons of steel are in the structure. The area served is equivalent to two city blocks.

cranes, each one powered by two such motors, can be operated singly or in tandem. Operating together, coupled by an equalizer bar, the cranes can lift 500 short tons at 10 feet per minute and transport this tremendous load anywhere in a two-block area for repair. With this lifting capacity, it is possible to lift an entire gun turret from our largest battleships. To conduct electric power to each crane, over 1½ miles (8200 feet) of collector rails were installed. Motors, generators and controls were supplied by the General Electric Company to the Alliance Machine Company, Ohio, which designed and built this massive project in conjunction with Navy engineers from the Bureau of Yards and Docks.

The new principle of hoist control, developed by G-E, gives high speeds when handling light loads and slow speeds with heavy loads for either hoisting or lowering operations. This characteristic has been previously combined with hoisting equipment but it is new for lowering operations. The hook load reaction regulates the voltage supplied to hoist motors so that speed is automatically reduced as loads increase.



Each crane is powered by two 135-hp. General Electric motors that operate on a new principle of hoist control. Hook load reaction regulates voltage, and speed is automatically reduced in proportion to the load, both for hoisting and lowering operations.

This not only permits safer and more efficient handling of crane loads but protects both life and equipment.

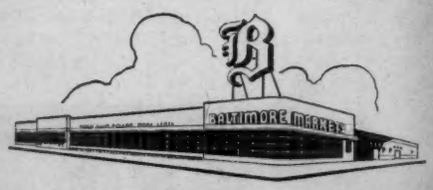
The crane structure is massive and is designed to withstand weather extremes and earthquakes. The 730-foot runway spans a pier 405 feet wide, extending 162 feet over the bay on each side. The cranes have a span of 142 feet and, when operating over the water, have a vertical range of 185 feet. Over 10,000 short tons of steel went into the project. With this new mammoth crane assembly, high speed repair service is now available to all units of the Pacific fleet. Repair work which formerly required days can now be completed in a few hours. Fittingly, the structure was dedicated on Navy Day.

Light Weight Crane Made from Pipe

SERVICE

A useful, easily constructed crane is of definite assistance in picking up and delivering small motors and refrigeration equipment to the customers of the S. J. O'Brien Sales Corporation in New York City.

A large-diameter pipe runs along the center line of a pick-up truck. The front end of this pipe is capped while the tail end is closed by a pivoting circular steel cap which can be pushed to one side with ease, but normally remains over the pipe end due to



New Super Food Store Always Modern with WALKERDUCT

Joseph Margolis
Architect, Phila.

Joseph Sand
Engineer

Electric Constructors, Inc.
Millville, N. J.

A THOUSAND ELECTRICAL OUTLETS AVAILABLE IMMEDIATELY FOR ANY CHANGE IN STORE LAYOUT

Baltimore Markets, in planning their giant food store in Camden, New Jersey, realized the need for a flexible electrical system. WALKER, pioneer in the field of underfloor distribution, supplied the answer. "Locked-in" inserts provide outlets for power and light from concealed raceways running the length and breadth of the 30,000 square feet of floor space. Connections for light and power for any point on the floor at any time in the future may be quickly and cheaply made without disturbing the terrazzo floor. WALKER "Preset" method of underfloor distribution works just as well in office buildings, banks, factories, and schools.

For further details, write for our Catalog #146 or consult Sweet's Architectural Files.

WALKER BROTHERS
Conshohocken 61, Pa.

walker of Conshohocken UNDERFLOOR SYSTEMS

Two sections of pipe, one fitting inside the other, form the support for a hand-operated chain hoist on one of the S. J. O'Brien pick-up trucks. The larger pipe is rigidly attached to the roof of the truck and is capped by a pivoting flap when the hoist is not in use. The inside pipe is fitted with a sturdy hoist ring to hold the lifting rig. The inner pipe is pushed entirely inside the larger pipe when not in use.

natural gravity. This large pipe is attached to the truck roof by triangular steel plates.

A second length of pipe, approximately the same length but of a slightly smaller diameter, fits inside this large pipe. A sturdy steel ring cap is brazed into the tail end of this second, smaller pipe.

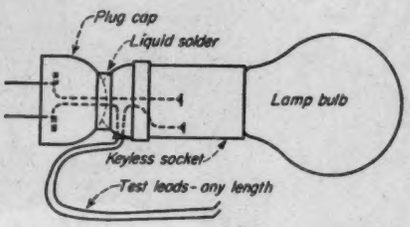
When not in use, the smaller pipe can be pushed entirely into the larger one and becomes an inconspicuous part of the roof. The pivoted end cap hangs over the tail end, preventing the small pipe from slipping from this casing. When it is necessary to raise or lower a fairly heavy piece of equipment to or from the tailboard of the truck, the pivoted cap is pushed aside, the ring end of the smaller pipe is pulled a foot or so from inside the larger pipe, and a hand-operated chain hoist is attached to the ring. Enough of the smaller pipe remains inside the larger one so that the cantilever action of the load on the chain hoist does not damage or strain the assembly.

This shop-made assembly has proven of definite value in speeding loading operations. With its use, truck operators are protected against physical strains and equipment is protected against damage due to slipping or being dropped by loading personnel.

Handy Test Lamp

MAINTENANCE

M. L. Monson, superintendent of the Fosston Municipal Light and Power Co., Fosston, Minnesota, has found need for a test lamp to check continuity of circuits in motors, transformers, appliances and other electrical devices. He wanted it equipped so that it could be plugged into any receptacle,



Handy test lamp is made by soldering keyless socket and ordinary plug cap together and wiring leads in series.

and small enough to be easily portable. Not knowing where to purchase such a test lamp, he decided to make one. The accompanying sketch shows how it was done.

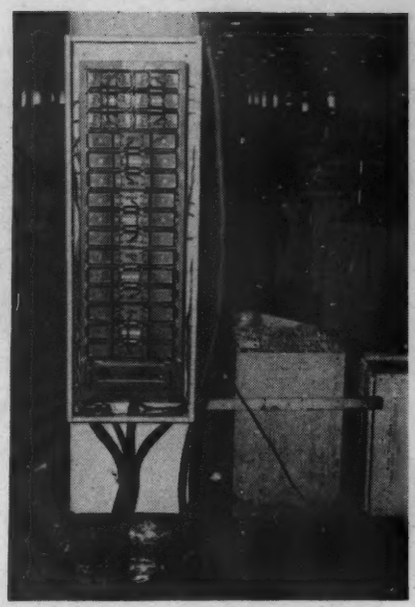
The socket cap of a keyless socket was cut so that it would fit a simple plug cap, and the two were then fastened together by liquid solder. The socket terminals and plug cap terminals were then wired, as shown, with the test leads in series. The result is a very handy little device which can be taken into the customer's premises for making various tests on appliances, locating shorts, and saving valuable time.

Temporary Wiring Concealed in Floor

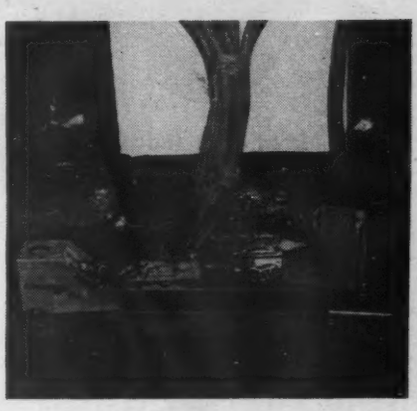
WIRING

When the J. F. Fisher & Company, Chicago electrical contractors wired the gigantic Machine Tool Builders Show held at the former Dodge-Chicago warplant, they found many cases where exhibitors wanted concealed temporary wiring to their machines. Solution to this problem was relatively simple since the plant floor in the area was the wood block type.

Fisher engineers designed and fabricated a sheet steel channel that was the same depth and about the same width as the floor blocks. Incorporated in the scheme were 90-degree offsets,



Temporary distribution panel feeding some 640 hp. of connected load in one machine tool exhibit booth. Note cables entering channel in floor for concealed runs to machine.

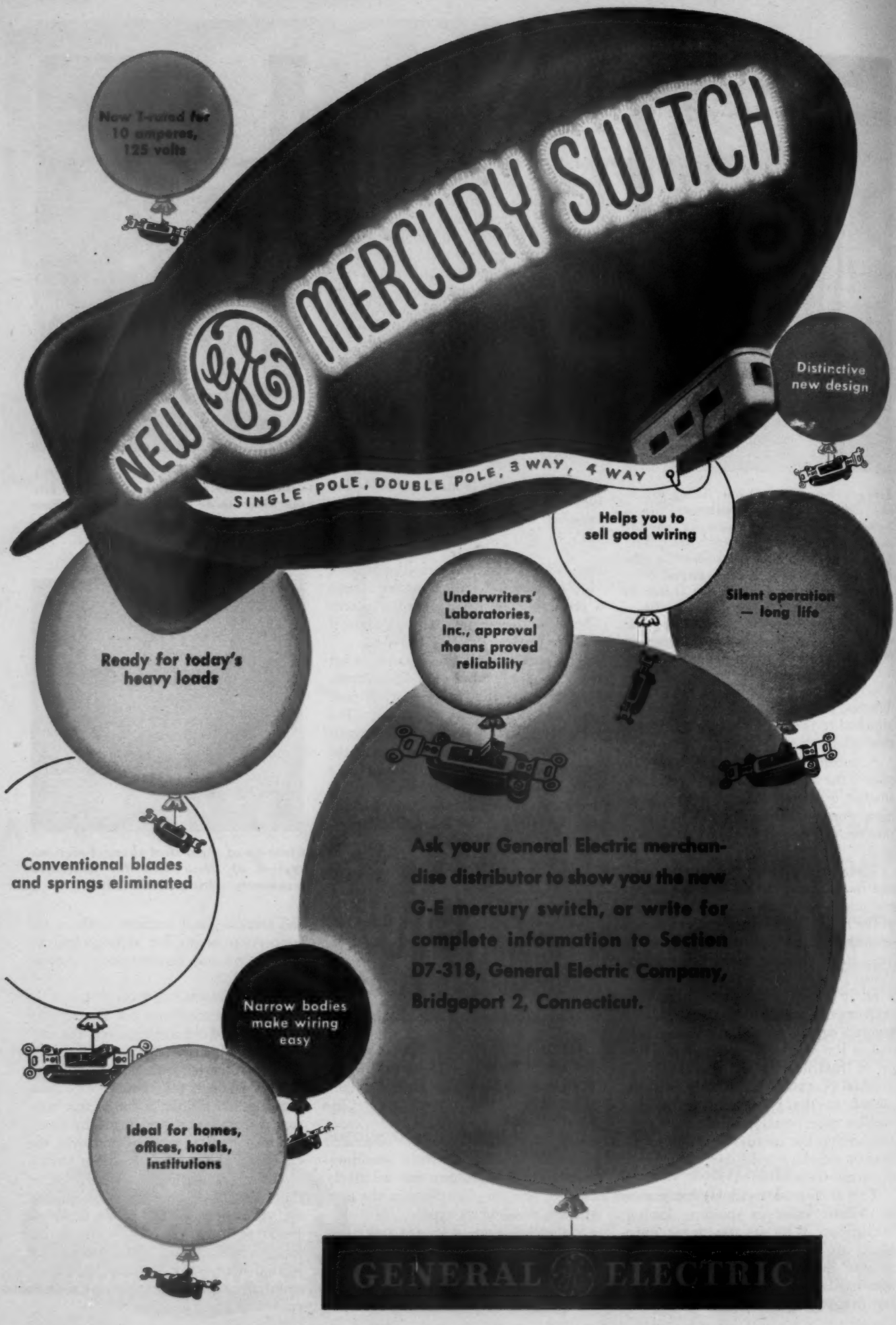


Close-up of sheet steel channel sections typical of those used for concealed temporary wiring at the show.

end-sections, and sections with raised connection boxes for either rigid or flexible conduit connection to motors or control.

Where circuits ran from distribution panels to the machines, the floor blocks were chiseled out and removed, the necessary conductors laid in the "trench" and the inverted channel placed over them. Although the channel was flush with the block floor, a completely concealed installation was made by pouring a molten tar composition over the channel and between it and the blocks.

When dismantling took place after the show, the channels were quickly and easily pried up and cables removed. Removed blocks were easily replaced. Blocks and channels are salvageable so that floors may be restored to their original condition and channels may be reused in other locations.


NEW GE MERCURY SWITCH
SINGLE POLE, DOUBLE POLE, 3 WAY, 4 WAY
Now T-rated for 10 amperes, 125 volts
Distinctive new design
Helps you to sell good wiring
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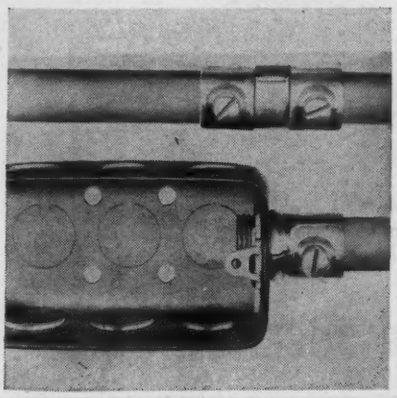
Ask your General Electric merchandise distributor to show you the new G-E mercury switch, or write for complete information to Section D7-318, General Electric Company, Bridgeport 2, Connecticut.
GENERAL ELECTRIC

Equipment News

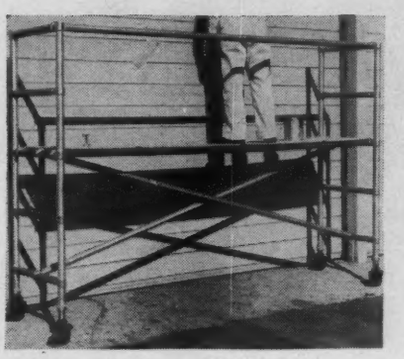
A-C Welder

This new a-c arc welder is designed for all around use, both in maintenance and production welding. A current range of from 25 to 250 amps., makes it possible to weld materials from light sheet steel to heavy plates or casting requirnig a ¼ inch welding rod. Type T-250 operates on the moving coil principle, providing continuous stepless current adjustment. There are no plug-in connections. Arc-blow is eliminated, welding speed is increased and substantial power savings result from its inherent high efficiency, it is claimed. Glass covered wire and mica insulation are used in the transformer coils. Dimensions are 18 by 18 by 37 inches. Mellaphone Electronic Rectifier Co., Inc., Rochester 2, N. Y.



Connectors and Couplings

A new line of pressed steel connectors and couplings designed and fabricated for use with electrical metallic tubing has been made available. Approved by Underwriters Laboratories, Inc., they have electro-galvanized finish and are said to be easy to inspect and advantageous for use in close quarters and corner installations. The EMT coupling slips easily over thinwall tubing ends. Positioning of the conduit is controlled by a small integral stop. Gripping is secured by the action of an embedding screw working through a boss. When the screw head is driven down to rest on the boss, the tip of the screw becomes embedded in the tubing wall. National Electric Products Corp., Chamber of Commerce Building, Pittsburgh 19, Pa.

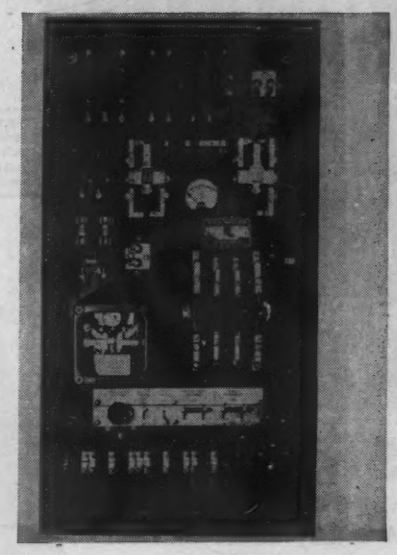


Scaffold

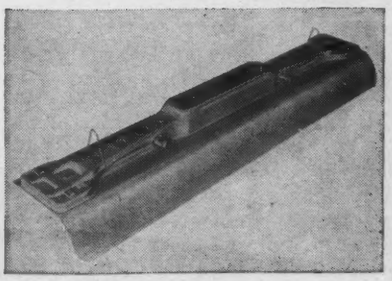
A portable 10 ft. span up-right scaffold has been announced. It is built of heat-treated aluminum alloy. The platform is adjustable to any height desired from 1½ ft. to 8½ ft. Adjustable legs insure a level scaffold on uneven ground or floor. Each leg has 24 inches of adjustment. This feature is provided by a locking collar and an expanding nut which allow sliding the threaded leg for instant adjustment. Hooks at ends of platform and at ends of braces lock in position automatically. The platform, 2 feet wide, is of waterproof plywood. It is recommended for many types of electrical installations and maintenance. Up-Right Scaffolds, Bank of American Building, Berkeley 4, Calif.

Switch

A series of special automatic transfer switches for fluorescent lighting circuits has been developed. They are designed to drop out from 75 to 93 percent of the voltage with pick up at 95 percent, percentages considerably higher than the drop out and pick up of switches designed for incandescent lighting circuits. By connecting an additional relay to the emergency source, this type of switch



can be made to discriminate between the two services, it is claimed. The close-differential relays included in the panel are classed Bulletin 1054-107S types. Voltage ratings are 110 to 550 volts, 60 cycles. Relays are available for separate control applications. Automatic Switch Co., 391 Lakeside Ave., Orange, N. J.



Fluorescent Fixture

The restyled HF-100 industrial fluorescent fixture introduces the "weatherizing" improvements. A weatherized finish on the reflector protects the metal fixture parts from rust, corrosion and pitting under damp and deteriorating atmosphere conditions. It is claimed that the new turned-down reflector lip minimizes collection points for dust, lint and moisture. The tophousing is made from a single sheet of steel. Single hanger hooks were specially developed for hook slots on each side of the tophousing. Designed as a two-lamp fixture, it is equipped with knockouts to provide for a third lamp if desired. Unit can be installed individually or in continuous row. Sylvania Electric Products Inc., 500 Fifth Avenue, New York, N. Y.

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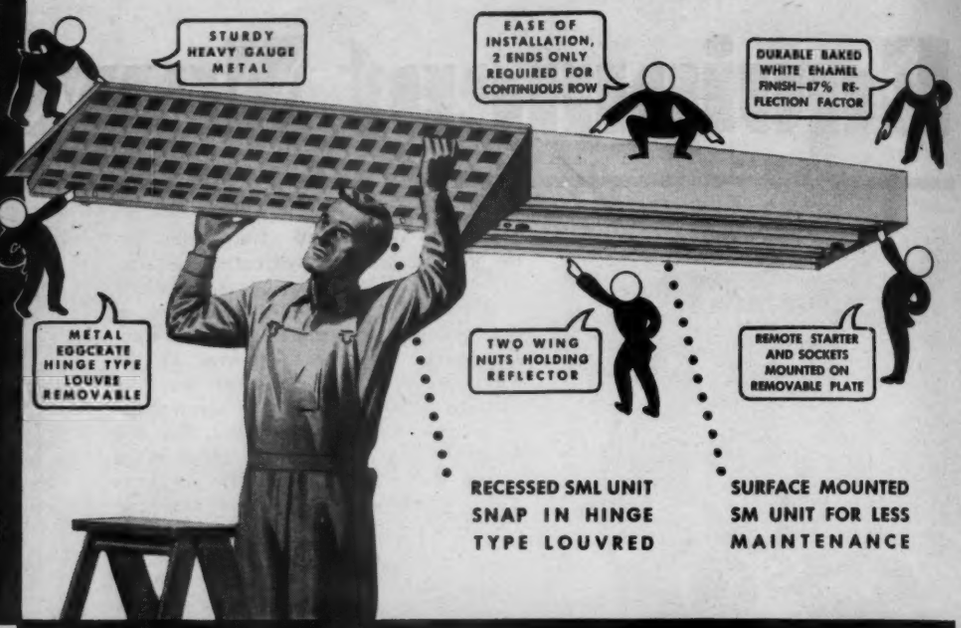
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EASE OF INSTALLATION, 2 ENDS ONLY REQUIRED FOR CONTINUOUS ROW
DURABLE BAKED WHITE ENAMEL FINISH—87% REFLECTION FACTOR
METAL EGGCRATE HINGE TYPE LOUVRE REMOVABLE
TWO WING NUTS HOLDING REFLECTOR
REMOTE STARTER AND SOCKETS MOUNTED ON REMOVABLE PLATE
RECESSED SML UNIT SNAP IN HINGE TYPE LOUVRED
SURFACE MOUNTED SM UNIT FOR LESS MAINTENANCE

SM SERIES

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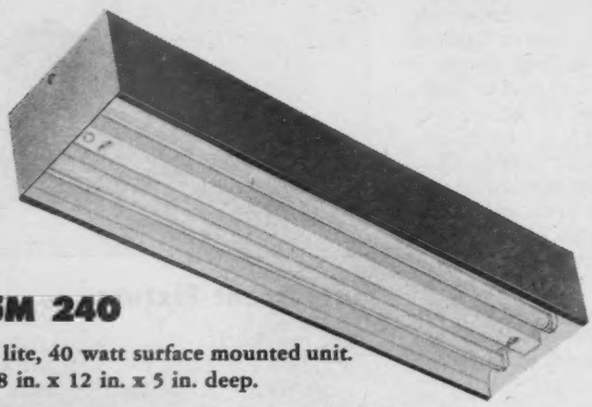

SM 240

2 lite, 40 watt surface mounted unit. 48 in. x 12 in. x 5 in. deep.

REC SML 240

2 light, 40 watt recessed unit. 48 in. x 12 in. x 5-in. deep.

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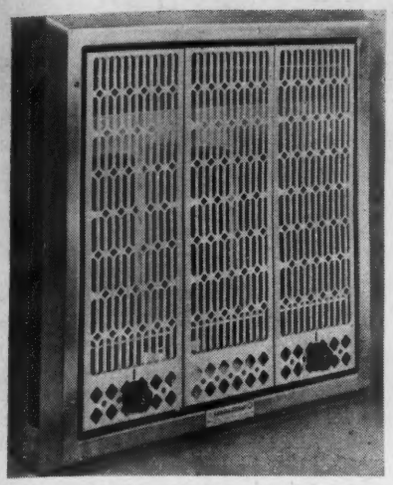
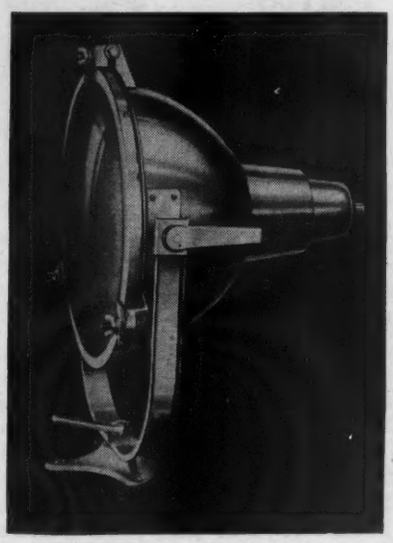


Electric Heater

A built-in thermostat with adjustable control for maintaining any desired temperature to provide economic performance is the feature of this new wall model heater. It is designed to be recessed in the wall, with modern grill suitable for any room. Approved by Underwriters Laboratories, Inc., it heats by both radiation and convection. The vertical semi-cylindrical heating element consists of nickel-chrome wire supported by a ceramic post. Units are available in 1500, 2000, 3000 and 4000 watt capacities and operate on 230 volts a-c. Electric Heating Dept., Westinghouse Electric Corporation, Emeryville 8, California.



Floodlight

New weatherproof, aluminum floodlights have been announced. They are available in 200 to 1000 watt lamp sizes. Each unit is complete with a silvered-glass Permaflector and a convex heat-resisting glass lens. Lens diameters range from 8⅜ to 18¾ inches. The floodlight housings are spun from one piece of sheet aluminum. Thorough design, precision engineering and careful construction assure maximum illuminating results under all weather conditions with minimum maintenance, it is claimed. All units are approved by Underwriters Laboratories. Pittsburgh Reflector Company, 410 Oliver Building, Pittsburgh 22, Pa.

Capacitors

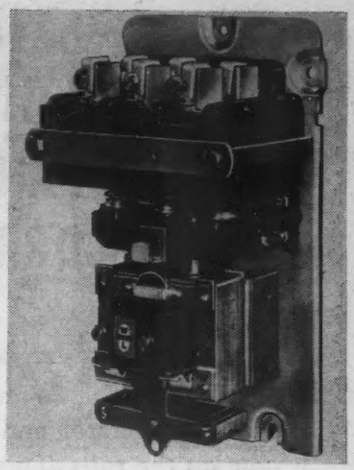
A new series of capacitors for power factor improvement of fluorescent lamp fixtures is now available. Type FF fluorescent fixture condensers are available in three ratings, for operation at either 118, 208 or 236 volts, 50-60 cycles a-c. Used singly or in recommended combinations, Type FF condensers will assure 85 percent power factor or better for all fixtures it is claimed. Condensers are provided with long leads and slotted mounting feet for easy installation. The capacitor impregnant used is non-flammable, non-explosive synthetic Superex. They are listed by Underwriters' Laboratories, Inc. Solar Capacitor Sales Corp. 1445 Hudson Blvd., North Bergen, N. J.

Photoelectric Control System

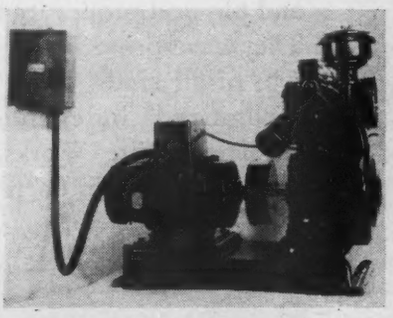
A new photoelecrtic combustion control system for commercial oil burners has been announced. It is composed of a master control unit, a photo-tube unit, and an electrode unit. The system is designed to shut off the flow of fuel to an oil burner immediately if the oil fails to ignite or if the flame is extinguished after successfully igniting. On gas-electric ignition systems it prevents fuel from flowing if the gas pilot does not ignite. The system allows the burner motor to operate for a definite period after shut-down in order to purge the nozzle or cup of unburned fuel. A complete starting sequence is assured after shut-down of burner. A self-checking circuit in the system prevent starting of the burner unless entire protection system is in proper operating condition. General Electric Company, Schenectady 5, N. Y.

Solenoid Contactors

Newly designed Size 2 Bulletin 4452 and Size 3 Bulletin 4453 a-c solenoid contactors have been announced. Intended primarily for use in a-c motor controllers, these new solenoid type contactors are also suitable for application in resistive heating controls, lighting controls, etc. for remote and automatic load switching purposes. Some of their features include compact unit construction; accessibility of parts; built-in solderless connectors, double break silver contacts; simplicity of design. All parts are arranged on a steel mounting plate having recommended NEMA and MTBA standard mounting



dimensions. Size 2 and 3 units have maximum ratings of 25 and 50 hp. respectively on 440-550 volts, 3 phase, 60 cycles. Standard operating coils with front-connected terminals are available for 110, 220, 440 and 550 volt operation on 25, 50 or 60 cycles. Ward Leonard Electric Co., Mount Vernon, N. Y.



Light and Power Plant

A new, fully automatic light and power plant that provides 1750-2000 watts, 115 volt, 60 cycle a-c has been announced. All controls are enclosed in two small metal cabinets, one mounted on the unit and the other on the wall. Recommended for service in homes, farms, construction camps, and for stand-by service, Model 2100-Ba provides ample power for electrical equipment and appliances and for considerable lighting. Whenever any light or appliance of 25 watts or more is turned on, the plant automatically starts and continues operation until the last light or appliance is turned off. Universal Motor Company, Oshkosh, Wis.

Light Control

The "Packaged" Powerstat dimmer is an autotransformer type of lighting control for use by community, school and other small theatrical groups. It offers three individual continuously adjustable autotransformer type dimmers in a self-contained cabinet with the mechanical means of interlocking each unit to a master control for group operation. Each

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The footage meter illustrated tells the operator automatically the exact length of tape on the rolls. This is but one of many measures used in the production of PANTHER and DRAGON Friction and Rubber Tapes that assure you of full value every time. And these tapes rate high in all the qualities that make for lasting splices.

Made by a company in the insulation business for nearly 70 years, PANTHER and DRAGON Tapes pass ASTM and federal specifications for electrical and physical properties with a wide margin of safety. They have proved their worth in successful splicing jobs of all kinds. These tapes are sold only through recognized independent wholesalers. Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pennsylvania.

6074

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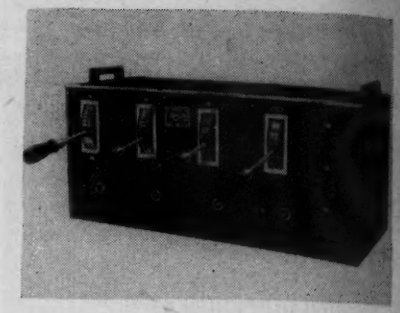
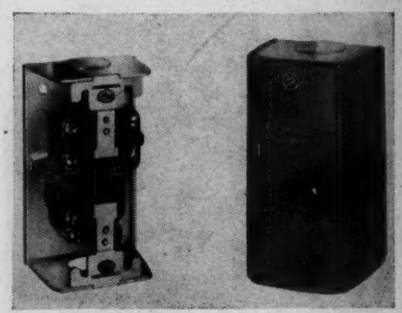


dimmer circuit is equipped with a silent circuit-breaker which combines an "on-off" switch with overload protection. Two sets of pin receptacles on the output of each dimmer accommodate standard 15 ampere pin plugs. Twist-lock receptacles can be furnished in place of pin receptacles. Each dimmer has a pilot lamp to show degree and color of light output. Each dimmer operates from a 115 volt, 50/60 cycle, single phase source with an output variable from 0-1700 watts.

Also available are the motor-driven powerstat dimmers. House lights can be dimmed from any location in the theatre by means of remotely controlled pushbutton stations. Units can be obtained with motor control in ratings up to 27,000 watts. The driving motor is a 115 volt, synchronous, brushless, ball-bearing type. Various speeds of travel from blackout to full-on are available. The Superior Electric Co., 1055 Hannon Avenue, Bristol, Conn.



Starting Switch

The new Bulletin 600 manually operated snap switch for starting motors of one horsepower or less has been announced. It is a streamlined unit with molded plastic cover, and has an overload device which operates on the soldered ratchet principle. It is impossible to hold the switch closed under sustained overload, but can be reset, with the regular switch lever, after the overload is cleared, it is claimed. Unit can be furnished without enclosure for mounting in a standard switch box or machine base. Allen-Bradley Company, Milwaukee, Wis.

Battery-Charger

A new motor driven battery charging unit designed for charging 6 cell lead acid, and 10 cell Edison batteries has been de-

[Continued on page 189]

Operational Efficiency Tests on D-C Motors—Part II

A discussion of six additional operational efficiency tests including determination of stray power losses.

By J. H. Hosmer
Electrical Engineer
Allis-Chalmers Mfg. Co.,
Norwood, Ohio

CONTINUING the description of operational efficiency tests on direct current motors presented in the previous article, we approach the final series of tests that complete the procedure. These include temperature, hot resistance, high potential, telephone interference, shaft current and the determination of stray power losses entering into overall efficiency calculations.

9. *Temperature Test* is made to determine the rise in temperature of specified parts of the machine as a result of its carrying its rated load or loads.

Temperatures may be measured by means of mercury or alcohol thermometers, resistance detectors, thermocouples, or by the increase in resistance of current carrying winding. The method used shall be as specified or implied in temperature guarantees in any case.

Thermometers must be free from breaks in the liquid column; positioned with the bulbs at a lower level than the stems. Bulbs should be covered with putty, cotton, waste or felt pads.

Before the heat run is started, thermometers should be placed on these stationary parts: Main and commutating coils, connector straps, and bearings. Thermometers should be placed on one main and one commutating field coil on each side of the machine. Three thermometers should be placed on each coil, one on the front side, one on the back, and one between poles as far in as accessible.

Thermometers which record the ambient air temperature should be placed in accordance with A.I.E.E. standards. The machine being tested should be protected from air drafts from adjacent machines which might cause an indeterminate effect on the apparent ambient temperature.

Immediately on shutdown, thermometers should be placed on the following parts: Three on the commutator at each side, one at the outer end, oue at the center, and one at the inner end; four should be placed on the armature core on the tooth tops on the armature conductors where they issue from the slots; four again should be placed on the conductors in the end winding if and where they are not covered by binding bands; four should be similarly placed in the binding bands.

Where size and accessibility in machines make it inconvenient, the number of thermometers may be reduced.

Precautions should be taken to shorten the stopping period, as for example, by maintaining the armature current. It is recommended that means be used to limit the stopping period to a value not exceeding that specified for the given rating, as follows:

Up to and including 50 kw...1 minute
Above 50 kw and including 200 kw. .....2 minutes
Abive 200 kw. .....3 minutes

Readings on all thermometers should be taken as long as the readings increase in value. The highest reading of any thermometer on any one part should be considered the temperature of that part.

10. *Hot resistance test* values of various circuits, such as series fields, armatures, and shunt fields may be found from the measurement of the cold resistance by the following method. A temperature coefficient of 0.38 percent, per degree centigrade for an initial room temperature of 25°C, may be assumed for the copper conductors. First, assuming a rise of 25°C., the increase in the resistance is approximately (.0038 x 25) 100 = 9.5 percent. By increasing the cold resistance 9.5 percent or by multiplying the cold resistance by 1.095 the hot resistance is determined.

If an increase in temperature of 40°C. is assumed, the increase in resistance is (.0038 x 40) 100 = 15 percent. Then by increasing the cold resistance by 15 percent or by multiplying the cold resistance by 1.15 the hot resistance is determined.

The hot resistance of any part of a machine, multiplied by the square of the current passing through that particular part gives the I^2R losses in that part of the machine. This measurement is also used for record purposes.

Hot resistance measurements are usually taken on the test floor by the same method as the cold resistance, except the machine has been put through the heat run when hot resistance measurements are made.

11. *High potential test.* On completion of heat run, and after completion of all other tests previously mentioned, the insulation puncture test is made by applying alternating current to the terminals of the machine at double normal voltage plus 1,000. If the insulation stands up under this potential test, the machine is passed. If the insulation breaks down, the machine is returned for new insulation replacement.

12. *Special tests: Telephone interference factor.* This factor is an arbitrary weighted number which indicates the tendency of all harmonics or ripples in d-c voltage to cause interference in a telephone line "exposed to" or "coupled" electrostatically or electromagnetically with a d-c feeder or network.

These troublesome harmonics are measured at the terminals of the machine while it is operating at no load, with full voltage applied. A tuned network designed for an arbitrarily weighted response to the various harmonics is connected across the terminals of the machine. The total current passed by the network is measured and expressed in microamperes per volt of terminal pressure. This number (microamperes and terminal volts) is the telephone interference factor (TIF).

This determination should be performed only by those who are especially qualified and are in possession of the harmonic detector.

13. *Test for shaft currents* is made to determine if a current is flowing between the shaft and bearing due to stray fields.

The procedure is to operate the machine at normal speed, voltage, and load. Hold a short piece (two feet or less) of heavy copper wire (No. 8 or larger) with one end against the bearing housing. Allow the other end to rub against the rotating shaft. The presence of sparks at this sliding contact may be taken as evidence that there is a current flowing between the shaft and bearing.

Determining Stray Power Losses in D-C Machines

14. *Stray power losses* include: (1) iron losses due to flux distortion; (2) eddy current losses in conductors due to transverse fluxes occasioned by the load currents; (3) eddy current losses in conductors due to tooth saturation resulting from distortion of the main flux; (4) tooth frequency losses due to flux distortion under load; and (5) short circuit losses of commutation.

For calculating the conventional efficiencies of D-C generators and motors, stray power losses are taken as one percent of the output. (present A.S.A. Standard).

To measure stray power of a machine, whether it be a motor or a generator, it should be run as a motor without load. The field and field rheostat is connected in series across the line. The armature also is connected across the line. Field current I is adjusted to provide rated speed at no load.

The total power input to the machine is then:

$$W = E \times (I_f + I_a)$$

where: W = Power in watts
E = Terminal Voltage
I_f = Field Current (amps.)
I_a = Armature Current (amps.)

Total power input W is distributed as follows: Part is consumed in supplying the field losses and the armature plus interpole $I_a^2R_a$ loss. The remainder supplies stray power loss. Therefore:

$$E_aI_a + E_fI_f = EI_f + I_a^2R_a + SP$$

SP = Stray power

$$= (E_aI_a + E_fI_f) - (EI_f + I_a^2R_a)$$

The stray power is equal to the total input to the machine minus the field and armature loss in watts.

For example: Consider a shunt generator running light as a motor at 1,000 rpm., taking 28 amperes from a 250-volt bus. The field current is 2 amperes and the armature plus interpole resistance is 0.06 ohms.

Stray power loss of the machine at this particular value of flux and speed is computed as follows:

Using the above formula:

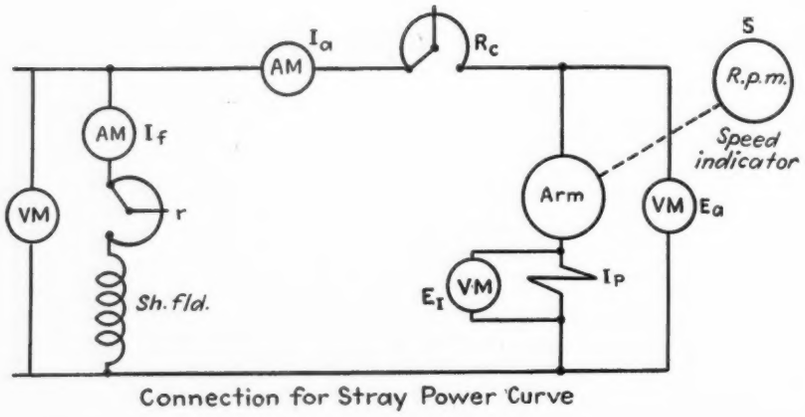
$$SP = (E_aI_a + E_fI_f) - (EI_f + I_a^2R_a)$$

where: $I_a = 28 - 2$ (field amps.) = 26 amps.

$$SP_s = (250 \times 26 + 250 \times 2) - (250 \times 2 + 26^2 \times 0.06)$$
$$= (6500 + 500) - (500 + 40.56)$$
$$= 7000 - 540.56 = 6{,}459.44 \text{ watts}$$

Stray power is a function of flux and speed only. It does not change unless either the flux or speed, or both change. In a motor-generator set the motor supplies the stray power loss, mechanically, and the generator supplies the electrical losses.

Assume that the above generator is delivering 50 amps. at 250 volts and 1,000 rpm. The field current is 3 amperes. It is desired to determine the stray power loss under these conditions.



Connection for Stray Power Curve

FIG. 2—Diagram shows instruments needed to measure and compute stray power losses on a shunt wound machine. I_f is current applied to shunt field through rheostat "r" with values adjusted to meet curve values in Fig. 3. I_a is armature current as adjusted by rheostat R_c. E_a is voltage drop across armature; E_I that across interpole. S records speed as indicated on stray power curve ordinates. Instrument readings are substituted in formulae outlined to plot curves in Fig. 3.

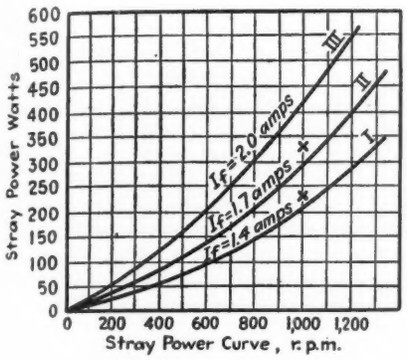


FIG. 3—Stray power curves represent relative changes in speed at time of change in field currents; also change in stray power losses throughout entire speed range at various field current values. Curves above designed for a 1200 rpm. machine for use on either motor or generator. Procedure is identical throughout speed ranges of all sizes of D.C. machines.

If the full load e.m.f. and speed (s) be duplicated when machine is running light, the stray power will be the same as under full load condition, except for indeterminable losses which have been assigned by A.S.A. Standards as 1 percent of the output.

When the machine is running light as a motor the stray power is measured as follows:

First consider the machine loaded, and the induced e.m.f. equal to:

$E = 250 + (53 \times 0.06) +$ 2-volt drop for brushes
$= 250 + 3.18 + 2$
$= 255.18$ volts
$s = 1000$ rpm.
$SP = 1115$ watts
Total Loss = 3,558 watts

Then:

$$\text{Efficiency} = \frac{\text{output}}{\text{output} + \text{losses}} = \frac{250 \times 50}{(250 \times 50) + 3558} = \frac{12,500}{16,058} = 77.8 \text{ percent}$$

Stray power curves at different field currents. The stray power of a d-c machine over considerable ranges of output is sometimes desired so that sufficient data can be had for obtaining stray power under various operating conditions.

Stray power is a function of two variables, namely flux and speed; therefore, a single curve does not represent a true picture under all conditions. Either the flux, or the speed, is held constant, and the other is varied when plotting a curve. It is convenient to hold the field flux constant and vary the speed by varying armature current I_a by use of the rheostat R_e (See Fig. 2).

In the stray power test, the field current is held at a definite value and the speed is varied over the working range of the machine, after which the field current is again set at a new value and the test repeated. Three or four values of field currents are used, ranging from the minimum value of field current I_f over which the machine can be worked, to the intermediate and maximum values.

By this procedure, curves similar to those shown in Figure 3 are obtained.

The curve in Figure 3 represents stray power curves taken on a 10 kw., 250-volt shunt wound generator run at light load as a motor and using the method just described. The rated current of the generator is

$$\frac{10 \text{ kw.}}{250 \text{ volts}}$$

= 40 amperes, and the armature plus interpole resistance is 0.183 ohms.

In determining the efficiency of the above machine, as a generator at half load, and at full load, the voltage is kept constant at 250 volts in each case. The value of the field currents are 1.5 and 1.8 amperes, and the speed is constant at 1,000 rpm. Proceed as follows for half load computations:

Let $I = \frac{40}{2} = 20$ amps.

$I_a = 20.0 + 1.5 = 21.5$ amps.
$I_a^2R_a = (21.5) \times 20.183 = 84.5$ watts.
$EI_f = 250 \times 1.5 = 375$ watts.

In Figure 3 on the 1,000 rpm ordinate, one-third the distance between curve I and II is equal to 1½ amperes and the stray power for this load is 230 watts, as indicated by the letter X on the abscissa 230 of the curve.

The efficiency at half load is:

Efficiency —

$$\frac{250 \times 20}{(250 \times 20) + 84.5 + 375 + 230 + 50} \text{ (indeterminable)} = \frac{5000}{5739.5} = 87.2 \text{ percent}$$

For full load: $I = 40$ amps.
$I_a = 40 + 1.8 = 41.8$ amps.
$I^2_aR_a = (41.8)^2 \times 0.183 = 320$ watts.
$EI_f = 250 \times 1.8 = 450$ watts.

In Figure 3 on the 1,000 rpm ordinate line, one-third the distance between curve II and curve III is equal to 1.8 amperes, and the stray power is 330 watts, as indicated by the abscissa on the 330 line. The efficiency at full load is:

$$\text{Efficiency} = \frac{250 \times 40}{(250 \times 40) + 1,200 + 450 + 330 + 100} \text{ (indeterminable losses)} = \frac{10,000}{11,200} = 89.3 \text{ percent.}$$

To make adjustments of E and S, the generator is run as a motor connected as in Figure 2 with armature voltage E_a adjusted to 223.42, for instance, and with the ammeter connected directly in the armature circuit and a voltmeter connected across the armature terminals. The variable voltage is adjusted so that E_a, armature voltage = 223.42. Of course, the small armature drop under this condition is negligible. The field rheostat is then adjusted to provide a speed of 1,000 rpm. The machine has now reached the same speed level, and both the speed and flux are of the same value as they were under the given load. Therefore, the stray power is the same in the two cases, and is equal to $E_aI_a - I_a^2R_a$.

Assume that in Figure 2 the current and voltage values are: $I_a = 5$ amperes and $E_a = 223.42$ volts, neglecting the small drop in armature ($5^2 \times 0.06$). The stray power, S.P. = $E_aI_a - I^2_aR_a = 223.42 \times 5 - (5)^2 \times 0.06 = 1117.1 - 1.5 = 1115.6$ watts.

To determine the efficiency of the generator, proceed as follows:

Output under load was 250 x 50 = 12,500 watts.

$I^2_aR_a = (50 \times 3)\ 2 \times 0.06 = 169$ watts.

Brush $I^2R = 53 \times 2 = 106$ watts.

$EI_f = 250 \times 3 = 750$ watts.

One percent load loss = (50 x 250) x .01 = 125 watts.

$$\text{Efficiency} = \frac{250 \times 50}{(250 \times 50) + 169 + 106 + 750 + 125} = \frac{12,500}{14,765.6} = 84.7 \text{ percent approximately.}$$

These procedures for efficiency tests are comparable on both large and small machines.

The step-by-step method as outlined in these articles simplifies the procedure; eliminates complications that might arise and provides a true story of the capability of the machine under question.

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Reader's Quiz

Converting A Motor

QUESTION 269—I would like to know how you can take a 25 cycle fan and use it on a 60 cycle installation? We have a 25 cycle fan which we have taken out of a building which had 25 cycle current. I would like to know if we can use it in a building with 60 cycle current? We have tried the fan. It runs very slowly. Can anything be done to make it run at a normal speed?—I.F.

A. TO QUESTION 269—There are three methods of converting a 25 cycle motor for use on 60 cycle circuits. The simplest is to operate the 25 cycle motor at double its 25 cycle rating on 60 cycle. Thus, operate a 110 volt 25 cycle motor at 220 volts 60 cycle. This may, however, be impractical as the motor will operate at twice its rated speed and horsepower. In case of a small or any size fan this is or may be dangerous due to increase of the peripheral speed of the fan blade, also the rotor, causing either to fly apart. The conversion by reconnection will produce the same results so if the first method is discarded due to the results, so must the thought of reconnecting the internal winding. The only practical method of change, where approximately the same speed is to be maintained, is by rewinding. This is done by producing twice as many poles for 60 cycle operation. This is usually done in the following manner: rewind the new coils for one-half the original coil span, the next larger size of wire being used and with 84 percent of the original turns. The internal winding connection method remains unchanged. This will produce a slight increase in power and speed, but not to the range of impracticability.—L.R.D.

A. TO QUESTION 269—It is quite possible that this 25 cycle motor can be rewound or reconnected for operation on 60 cycles. Send the identification marks appearing on the motor nameplate, such as serial number, model number, and full motor rating, to the motor manufacturer and they should be able to state just what is required to be done. It would be well to check the cost of rewinding against the cost of a new 60 cycle motor because a 60 cycle machine of same hp. rating and approximately same speed may be found to cost only a third or a quarter as much as a comparable 25 cycle machine. Assuming the 25 cycle machine is 2 pole, 1500 rpm., the nearest 60 cycle speed will be either 4 pole, 1800 rpm or 6 pole, 1200 rpm. Whether or not the slot combination of this particular motor will permit changing to a different number of poles can only be determined by checking the winding diagram.

Physically, a 25 cycle motor will be found to be much larger than the corresponding 60 cycle machine of same hp. and the nearest possible speed. This accounts in large degree for the higher cost of the 25 cycle machine.

The reason the present motor runs slowly on 60 cycle is doubtless because the torque it can develop on 60 cycles is only $(25/60)^2$ or 17 percent of the original 25 cycle torque. The torque of a motor varies inversely as the change in frequency. A fan load builds up pretty fast as the speed increases so that as the motor comes up to speed a place is found where it can't accelerate any further. If the fan was disconnected the motor would probably run up to 60/25 or 2.4 times its original 25 cycle speed because the synchronous speed of a 2-pole, 60 cycle motor is 3600 rpm. and the synchronous speed of a 2-pole, 25 cycle motor is 1500 rpm. —R.F.E.

Generator

QUESTION 270—How can I change a 12 volt Dodge generator to run on 110 volt a-c? Kindly show diagrams.—E.P.R.

A. TO QUESTION 270—This is a very serviceable 110 volt a-c 60 cycle ½ hp. synchronous motor which we built from a Dodge generator and including a "squirrel cage". The purpose of the squirrel cage is to smooth out the somewhat uneven operation, or vibration called "hunting action". By eliminating this hunting action as far as possible, the life of the motor will be lengthened and its power increased.

To help you construct this motor here are diagrams of the squirrel cage, pole shoes, armature windings & wiring diagrams.

The squirrel cage should be constructed as shown, of heavy solid copper firmly soldered at all joints. Of course it has to be of the right length to fit inside the endbells.

The pole shoes should be drilled $\frac{11}{16}$ inch as shown, to take a No. 6 round copper wire, you can use regular No. 6 D.C.C. and remove the cotton covering. The pole shoes can best be drilled by placing them in the frame, securing it, then drill very carefully to prevent the drill from leading. The cage cannot be installed in the frame as you know, until the field coils are in place.

Field coils—the series or heavy winding is put on first, and consists of 50 turns of No. 15 heavy Formvar wire. Shunt winding has 350 turns of No. 21 Formvar wire, wound in the same direction as the series coils, but cross the leads of two of them, to reverse the flow of current in alternate coils.

Armature winding—first you put on the d-c winding which is a wave type winding consisting of 6 turns of No. 17 heavy Formvar wire per coil. Each coil is wound as shown in detailed diagram, and each coil follows a similar course to that of the first. Next put on the a-c winding consisting of 12 turns of No. 16 heavy Formvar wire. The start and finish leads of this winding protrude from the end of the armature opposite the commutator. Following diagram closely, you will note that the direction of the winding is reversed after six coils are completed each time.

Next you will have to make or get a collector ring and one brush holder, to carry the current from the a-c winding outside the frame. Place the collector unit permanently as close as possible to the winding. The other side of the winding is grounded to the rotor. The only change in the brush rigging is the removal of the regulating or moving

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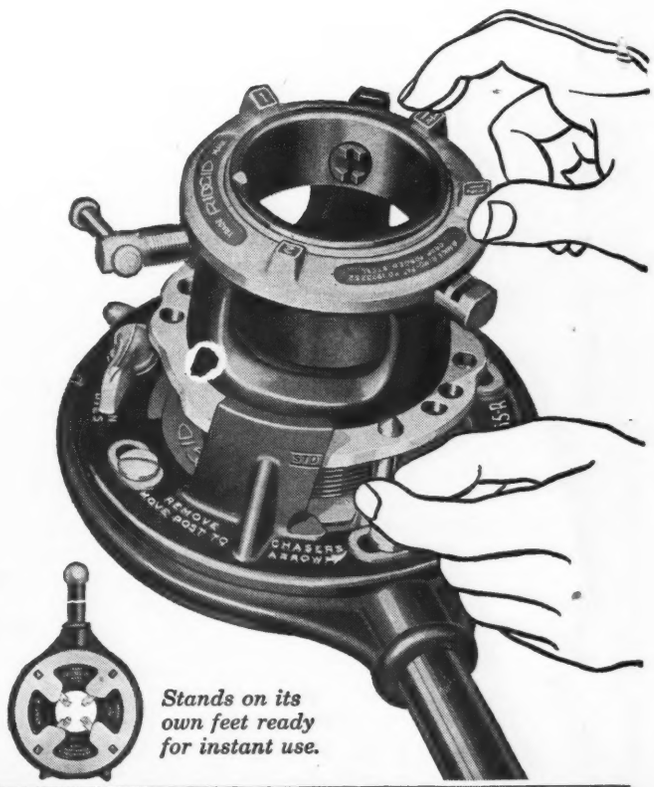

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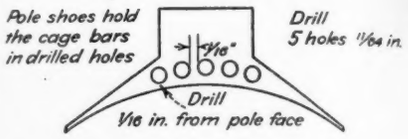
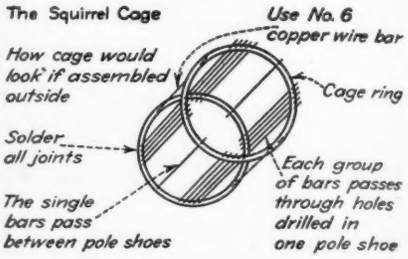
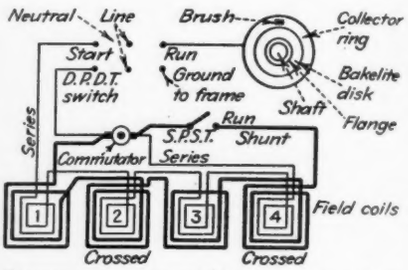
End View of Pole Shoe



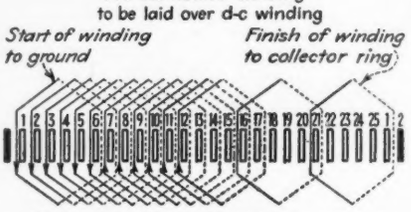
The Squirrel Cage — Use No. 6 copper wire bar


How cage would look if assembled outside
Cage ring
Solder all joints
Each group of bars passes through holes drilled in one pole shoe
The single bars pass between pole shoes



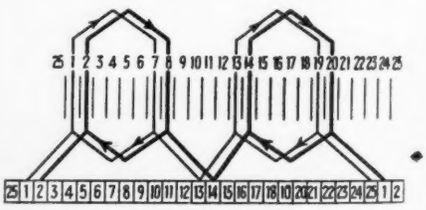
To operate, close top switch in start position. When proper speed is reached throw to run, closing bottom switch a split second ahead of top switch

A-c distributed winding to be laid over d-c winding



Change direction of winding at end of 6th coil each time

D-C Winding—"Wave Type"



Commutator bars
There are two connections to each bar riser

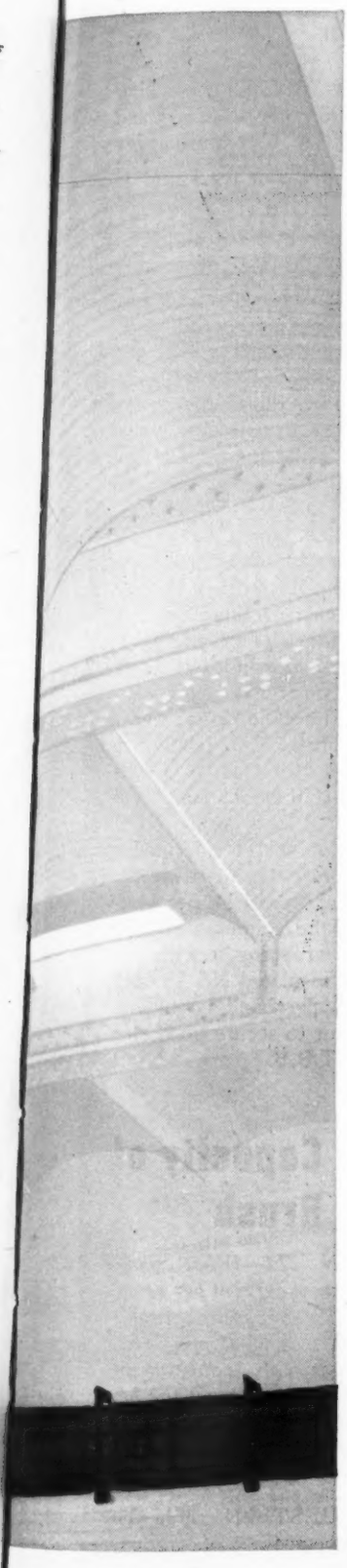
brush. Only stationary brushes are used.

I have illustrated the wiring diagram very clearly. The D.P.D.T. switch is to control the a-c input, S.P.S.T. switch is to place the shunt winding of the armature in the circuit. Connect ground wire to frame.

In operation, allow the motor to attain its full speed before making the changeover to the run position, as it will not pick up speed after the change is made, but will tend to stop if it is turning over too slowly. If the rpm. is more than 1800 at the time of changeover, the motor will drop back to 1800 rpm. and attain that speed.

Approximately 25 volts d-c may be

after installation



SALES come more easily with BullDog Ventilated "Lo-X" BUStribution DUCT. A product with so many good points is bound to be a world-beater. What's more, *superior performance* sells "Lo-X" again and again, long after installation.

Power really toes the line when it flows through BullDog BUStribution DUCT. Here's a system that's rugged and *right!*

Selling features

BullDog Ventilated "Lo-X" BUStribution DUCT is designed for large feeder runs transmitting currents up to 4000 amperes at 600 volts or less. It is entirely prefabricated for quick assembly and installation, as well as 100% salvable.

There's no 'unknown factor' about "Lo-X", either. Standardization of parts and pretesting mean positive knowledge of performance . . . long before installation. Estimates can be made accurately in jig-time!

Ventilation of BullDog "Lo-X" BUStribution DUCT means less temperature rise, giving increased current-carrying capacity. Conductors are arranged in "paired phases" with silvered copper bus bars close to each other. Means neutralization of magnetic fields and less voltage drop.

Repeat business

Repeat orders come only from satisfied customers. Maintain a good reputation by recommending the product you believe best for the job to be done.

Know the product. It's easier to sell that way. Acquaint yourself with the fine selling points of such items in the BullDog line as "Lo-X" BUStribution DUCT . . . and watch sales come easier!

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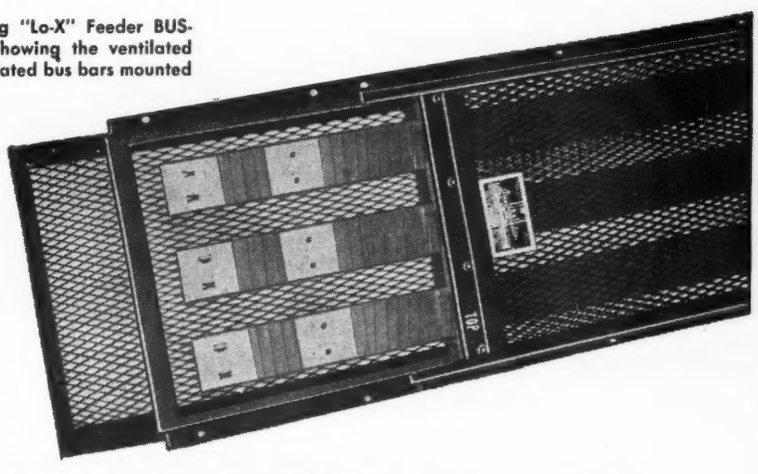

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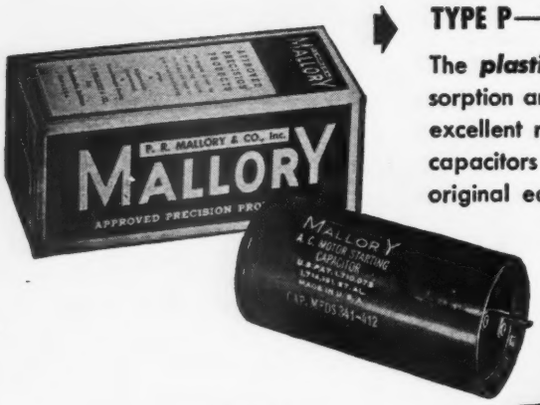

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obtained from the two commutator brushes while the motor is operating in the run position. A D.P.D.T. switch must be connected across the two brushes to provide a definite disconnection at any other time. The d-c may be used to charge batteries or light lamps of the proper voltage. About 250 watts are available.

A certain amount of adjusting and experimentation will probably be found necessary to achieve the best result from this motor. Run it as a series motor to check the direction of rotation.

When you have this motor working properly, the accuracy of its speed, and its great versatility will be found a fine reward for the painstaking care and effort you have spent in its reconstruction.—R.D.R.

A. TO QUESTION 270—It is not recommended that an auto generator or any d-c apparatus be revamped for a-c operation. In this case, the magnetic circuit is solid iron, therefore not suitable for an alternating flux, the induced eddy currents would be excessive and cause the iron to heat to such an extent that ordinary insulation could not be used.

The end brackets would have to be drilled to provide extra ventilation and the brushes relocated to satisfy the new condition. The cost of rebuilding the generator plus the cost of energy to supply the copper and iron losses would be prohibitive compared to the cost of a new motor of the same rating.

Since it is impractical to rebuild the generator for a-c operation, it is sufficient to say that it would run *inefficiently* reconnected as a series, repulsion or induction motor. If operated as an induction motor, the armature can be used as is, but it will be necessary to short circuit the commutator; this can be done by wrapping it with several turns of un-insulated No. 18 magnet wire, the copper band is soldered to the commutator to secure good electrical contact.—T.B.B.

Carrying Capacity of Graphite Brush

Q *UESTION 271—What would the maximum current per square inch be for a copper graphite brush? Out of what mixture in percentages of copper and graphite would one get the best results in commutation and maximum current per square inch? E.J.K.*

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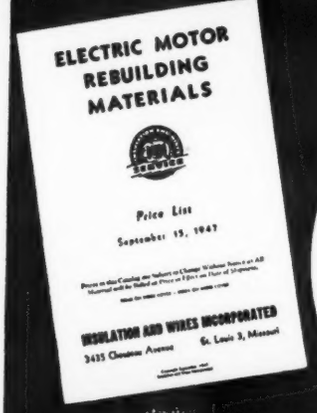

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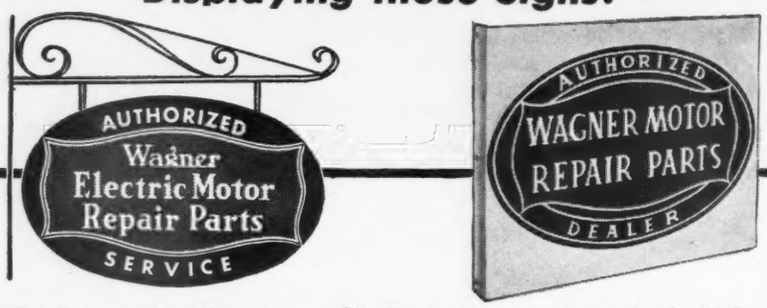
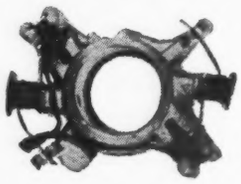


It takes genuine Wagner assembly-line motor parts to retain the high quality of Wagner motors.

Dependable switches for split-phase and capacitor motors.



Reliable brush-holder assemblies.

Correct grade brushes which assure satisfactory performance.

Steel-reinforced commutators.

Full-finished bi-metal bearings ready to install. May be had unbored for undersized shafts.

Pure wool wicks that actually filter the oil.

Ask for
CATALOG MU-40....

Every repair shop needs one. It helps you determine the catalog number and price of Wagner motor parts.

Wagner Electric Corporation
EST. 1891

6413 PLYMOUTH AVENUE
ST. LOUIS 14, MO., U.S.A.

ELECTRICAL AND AUTOMOTIVE PRODUCTS

AS49-1A

graphite brush is the maximum load current per square inch. It can carry continuously without overheating under normal operating conditions. This value may be as much as 50 percent higher in applications of intermittent operation, on slip ring machines, and on machines having very good commutation. The carrying capacity is determined not only by the load current, but also by the currents present as a result of commutator segment short-circuiting, contact friction, and contact resistance. The short-circuit current depends on the winding characteristics and the resistivity of the brush composition. Contact friction depends on the character of the surfaces. While a smutty surface will generally cause higher friction, highly polished surfaces of brush and slip ring may also cause a frictional drag as a result of the vacuum produced at the contact surface. Contact resistance depends on the nature of the surface formed between the commutator or slip ring and the brush. This contact resistance and the voltage drop across it vary appreciably on commutators and slip rings.

The higher the copper content of the copper graphite brush, the higher is its carrying capacity and frictional loss. While higher copper content lowers contact resistance and voltage drop for a given load current, the rate of contact resistance decrease is not in direct proportion to the percentage of copper increase. This is due to the copper oxide formed at the surface as a result of brush processing which may affect the specific resistance of a brush from 0.00000065 ohms per inch cube for pure copper to 600 times that value for pure graphite.

The best results to be obtained in commutation and maximum current per square inch depends primarily on the operating voltage and speed of the machine. A low voltage drop obtained by a high copper content brush is desirable for a low voltage motor or high current plating generator, the slip ring side of a synchronous converter, or for axle grounding service. The higher the speed, the higher should the percentage of graphite be to provide proper lubrication between the surfaces in sliding contact. On higher voltage machines, such as on a 125 volt motor or generator, a high copper content and low voltage drop brush would cause unnecessarily high short-circuit commutation currents and is therefore undesirable.—R.G.C.

A. TO QUESTION 271—The brushes which will give you best results will depend on motor circuit conditions and maintenances. Some brushes contain up to 95 percent metal. The maximum current a

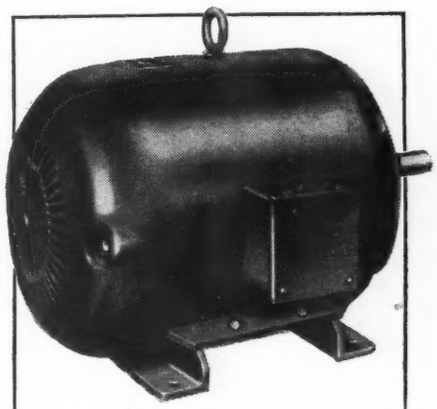
There's DIRTY WORK in STEEL MILLS

...but it doesn't bother Wagner *type CP* Motors

Wagner Totally-Enclosed, Fan-Cooled Motors (Type CP) are built to "take it" . . . They are completely *sealed* against harm from dust, dirt, steel chips, abrasives, acid fumes, or other destructive matter that would quickly ruin an ordinary motor. That's why steel mills, and other industrial plants throughout the world have thousands of these Wagner Protected Motors on the job, giving dependable service—doing big jobs—dirty jobs—without asking favors.

You, too, can rely on Wagner Quality Motors for continuous, troublefree performance in your plant. Investigate Wagner—the complete line . . . built by engineers who *know* how to build motors that meet your requirements. Nationwide service facilities are available to users of Wagner Motors.

Call any of our twenty-nine branch offices, located in principal cities and manned by trained field engineers, for advice on all of your motor problems. Bulletins on the complete line of Wagner Motors will be sent upon request.

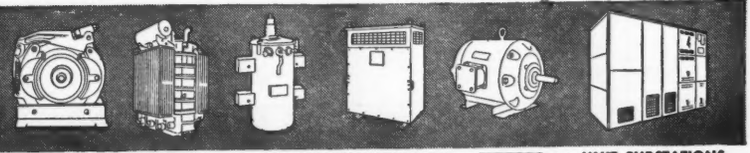


Pictured above is a Wagner totally-enclosed fan-cooled motor. Wagner makes a complete range of motors for every application.

Wagner Electric Corporation
6413 PLYMOUTH AVE., ST. LOUIS 14, MO., U. S. A.

Wagner Electric Corporation
EST. WE 1891

Consult Wagner Engineers on all Electric Motor Problems



BRIDGE BRAKES • POWER AND DISTRIBUTION TRANSFORMERS • MOTORS • UNIT SUBSTATIONS

M48-7

ELECTRICAL AND AUTOMOTIVE PRODUCTS

Avoid DELAY

SLEEVE BEARINGS

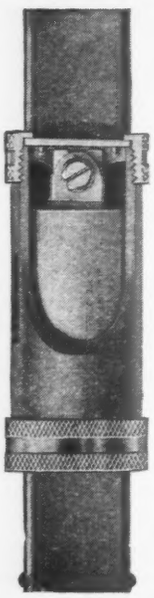
from STOCK

Over 250 types . . . completely machined, ready for installation await you in every Johnson Bronze Warehouse. They are made right . . . they fit right . . . and they last longer. Write for our new catalogue TODAY.

JOHNSON BRONZE
SLEEVE BEARING HEADQUARTERS
490 S. MILL STREET — THE MOST COMPLETE SLEEVE BEARING SERVICE in the WORLD — NEW CASTLE, PA.

Ask these questions

Before you buy or install Renewable Fuses



1. **"BARE-LINK" or TRICO "POWDER-PACKED"?** Which type will do the most for me?
2. **IS LINK PROTECTED?** TRICO renewal links are completely enclosed — no kinking . . . no twisting from shipping or handling.
3. **IS LINK SUPPORTED?** TRICO "Powder-Packing" supports the link — no sagging . . . no stretching.
4. **PROTECTION AGAINST ARC AND FLASH?** "Powder-Packing" protects tube & metal parts — no cleaning . . . no scraping necessary.
5. **WHAT DEGREE OF TIME-LAG?** TRICO "lag" is just right — not too much or too little.
6. **ARE EXPLOSIVE PRESSURES ABSORBED?** "Powder-Packing" prevents pressure build-up. Reduces fire and accident hazards.
7. **CAN HEAT DETERIORATE CASING?** "Powder-Packing" absorbs heat . . . protects casing.
8. **CAN I AFFORD NOT TO BUY TRICO?** Check for yourself . . . you'll find that only TRICO offers you ALL protection features — Even the links cannot be "Doubled-Up" or interchanged with inferior links . . . You get EVERYTHING when you specify TRICO.

WRITE TODAY FOR FREE BOOKLET
THE INSIDE STORY OF TRICO RENEWABLE FUSES

24 pages of fuse facts . . . Quick reading and informative . . . profusely illustrated . . . Tells how you can get maximum returns from your fuse investment . . . WRITE FOR BOOKLET No. 206-A.

TRICO FUSE MFG. CO. Milwaukee Wisconsin — TRICO FUSES

brush is made for is 150 amps. per sq. in. Other brushes carry 30 amps. per sq. in. One manufacturer lists 53 grades of brushes, and at the same time suggests care in the use of the brushes.—H.S.

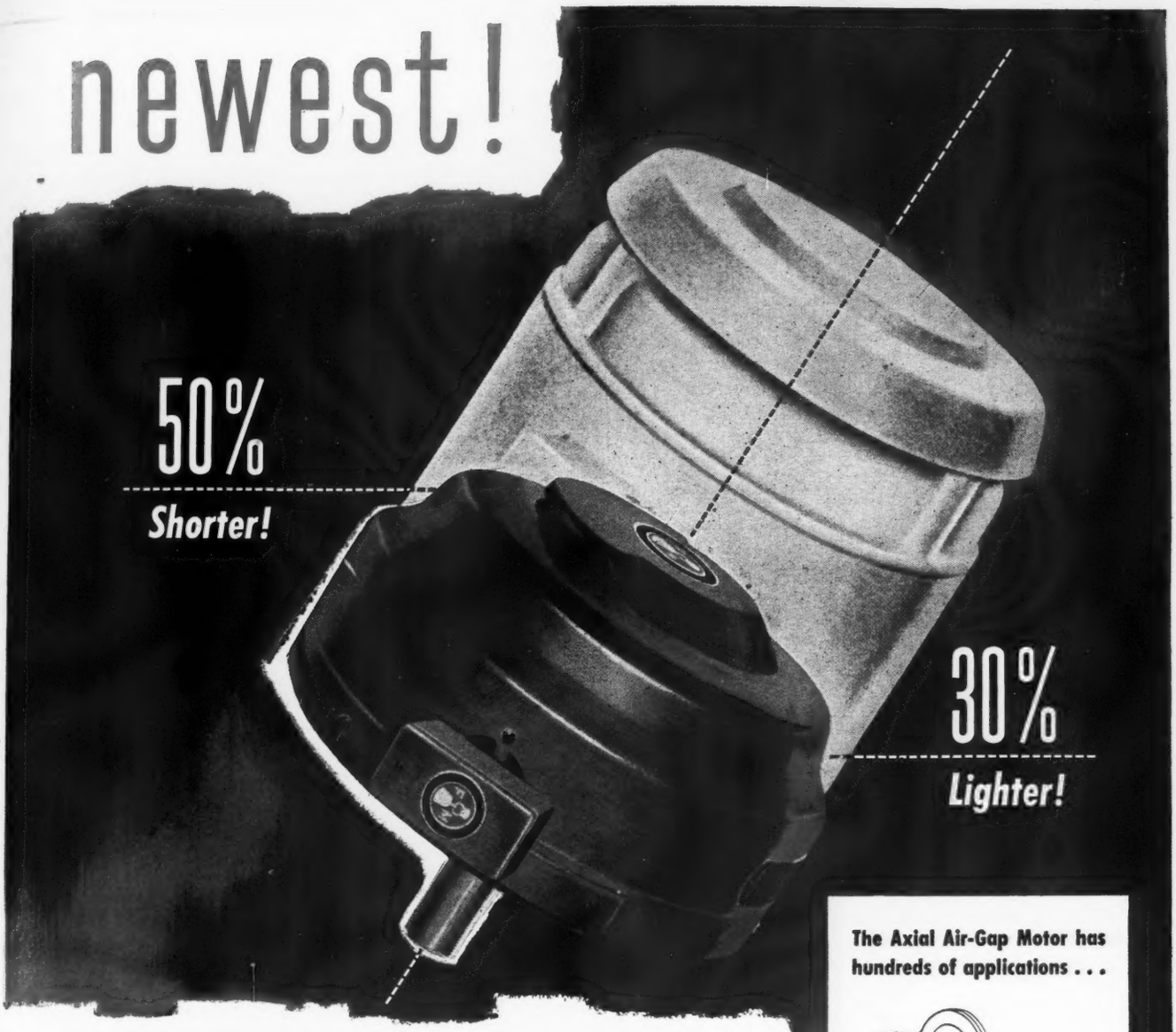
A. TO QUESTION 271—Some brush manufacturers have copper-graphite brushes rated as high as 150 amp. per sq. in. However, these grades are designed for plating generators up to 12 volts and contain only about 3½ per cent graphite. There are other grades for slip rings on heavily loaded synchronous converters that have a rating up to 135 amp. per sq. in. These grades have 65 to 90 percent copper. There are too many variable factors to say that a given mixture will give the best results in both commutation and maximum current per square inch. I would suggest that E.J.K. consult one of the many brush manufacturers and state the facts in his particular problem.—E.K.

Repulsion Induction Motors

Q *UESTION 272—I live in a 25 cycle district and occasionally get 60 cycle, R. I. motors for repair. Some of these repulsion induction motors have two brushes 90° apart and some have four brushes. Please explain if some of these have cross connectors or different type windings and why. Also, what are the advantages and disadvantabes of these different arrangements?*—J.H.G.

A. TO QUESTION 272—First it is presumed that the question refers to repulsion-induction motors literary and not to repulsion motors. The strictly R. I. motor type has two rotor windings, an ordinary induction rotor winding and a repulsion rotor winding connected to the commutator with short-circuited brushes. This is the two brush type with the brushes set 90° apart. The R. I. motor with four brushes has the above mechanical characteristics with the addition of having the second set of brushes connected to a compensating winding on the stator. The starting actions of these motors is that of a repulsion motor. However, due to the lack of a short-circuiting device, both the repulsion and the induction windings remain active, thus the motor when running functions as a combined induction and repulsion motor. The high starting torque makes this type of motor very desirable when heavy starting

newest!



THE FAIRBANKS-MORSE *Axial Air-Gap Motor!**

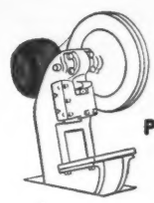
Here's the industry's newest electric motor, the most radical improvement in the design of standard rating 40-degree motors since their earliest days!

The Axial Air-Gap Motor offers opportunities heretofore beyond reach of those designers interested in conserving space, reducing headroom, cutting weight—and in improving the appearance of their product.

Write for Bulletin 2760—it has the information you'll be wanting.
Fairbanks, Morse & Co., Chicago 5, Ill.

***Air-Gap dimension is measured parallel to the axis of the shaft. Horizontal and vertical mountings; also, pivot base mountings. Polyphase squirrel cage and capacitor start, single phase types.**

The Axial Air-Gap Motor has hundreds of applications . . .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A name worth remembering

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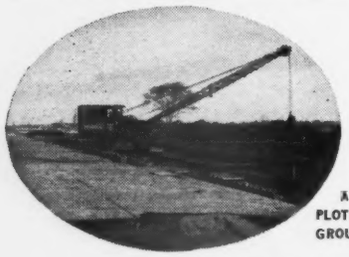
Silicone News

DC

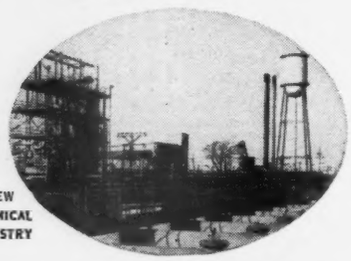
This is your party, too!

Now we're five years old. We can look back with some pride on what we've accomplished in that time. We look with equal satisfaction on the work done by our customers. Without their initiative no new material could have been adapted to so many different uses in so short a time. Working together, we have built a new chemical business to serve all industry.



1943

A PLOT OF GROUND



1948

A NEW CHEMICAL INDUSTRY

1943—We started with a legacy of some silicone fluids, 2 electrical insulating resins, a valve lubricant and an ignition sealing compound.

1948—We are now producing 60 different Dow Corning Silicone Products in the form of fluids and oils, greases and compounds, resins and varnishes and Silastic* all of which will do many things no other materials can do.

1943—We had essentially one customer and his name was Uncle Sam.

1948—Among our 7500 industrial customers are concerns in almost every major industry. Recently, we entered the consumers' market to bring silicones home to John Q. Public.

1943—We started to build a plant and a main office in Midland, Michigan.

1948—We have a large plant, now almost twice its original size, working full time to supply you with the silicone products you have come to depend upon. It's the first plant of its kind ever built. To pace our increasing productive capacity we now have branch offices in four major cities and two new ones about to be opened. In **1948** as in **1943**, we look forward, with your help, to a future busy with new silicone products and to a plant several times the size of our present one.

*TRADEMARK FOR DOW CORNING SILICONE RUBBER

DOW CORNING CORPORATION
MIDLAND, MICHIGAN

New York • Chicago • Cleveland • Los Angeles
In Canada: Fiberglas Canada, Ltd., Toronto
In England: Albright and Wilson, Ltd., London

Dow Corning
FIRST IN SILICONES

loads are encountered. The advantage of the four brush type is its high power factor over a varied load range; it is also more able to handle sudden overloads. Its disadvantage is in its original cost.—L.R.D.

A. TO QUESTION 272—The repulsion-induction motor has four brushes, two energy brushes and two compensating brushes. Perhaps you are getting this confused with the straight repulsion motor which has but two brushes. The straight repulsion motor has an armature like that of a direct-current machine. Short circuiting brushes provided 90° or 180° apart. A motor of this type has high starting torque with a very small starting current and rapidly decreasing torque with increasing speed. The power factor increases with increasing speed and near synchronous speed attains a value which is higher than usually obtained in straight induction motor.

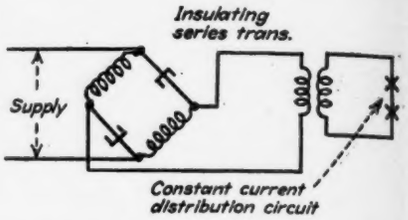
The repulsion-induction motor is like the straight repulsion motor except that in addition it has a compensating winding whose function is only to improve the power factor of the current taken by the machine. In addition to the energy brushes, a second set of brushes called compensating brushes are connected in series with the compensating winding. It has a starting torque equal to about two to three times full-load torque with approximately twice full-load current. The maximum torque is from 3 to 3½ full-load torque. A motor of this type has the disadvantage of having a commutator which carries part of the armature current continuously. It can be used for variable-speed service, by the insertion of a rheostat in series with the energy brushes.

You may also be confused with the repulsion-start induction motor, which starts as a repulsion but operates as an induction machine, after the centrifugal operated mechanism lifts the brushes from the commutator. In this motor all the brushes are connected together by the metal rocker arm which supports them. The stator has but one winding and there is no electrical connection between the stator and the rotor.—R.D.R.

A. TO QUESTION 272—There are various types of repulsion induction motors, but in general the one with two brushes is the simpler type and has the characteristics of a series motor, that is, its speed will decrease with increasing load. The motors (of various types) with four brushes have shunt characteristics, that is constant speed with varying load or may be provided with a means of controlling or varying the speed.—J.E.W.

Can you ANSWER these QUESTIONS?

QUESTION X12—A recent installation of series lighting uses a type of constant current transformer with



which I am unfamiliar. The diagram of the transformer is shown above. There are no moving parts. How does it work, on what theory?—L.R.D.

QUESTION Y12—I had an airfield lighting circuit that was grounded. There were 97 lights on the circuit with individual transformers for each light. Primary voltage 4160 with a secondary voltage of 140 volts at each socket. Output of each transformer has 50 watts.

In making tests I burned out two voltmeters set on the 600 volt scale. By putting a statiscope on the secondary leads, I would get a light indicating a primary leak, yet by plugging in the 50 watt 120 volt bulb it not only did not burn out but burned at its usual brilliancy. Several bulbs were used to make sure that it was not the bulbs.

Why did two voltmeters burn out indicating in excess of 600 volts, a light show on a statiscope indicating primary voltage and yet an ordinary 50 watt 120 volt bulb burn several hours without burning out?—F.A.S.

QUESTION Z12—We have a lot of lead acid type storage batteries in our plant used for emergency lighting, magnaflux, etc. Many times the question has arisen as to the kind of water used. One of the electrical maintenance foremen says that faucet water from the city system is as good and cheaper than distilled water, others say rain water caught in glass dishes should be used or use distilled water. My handbook says to use distilled or approved water. What is meant by approved water? Have any readers had actual experience as to the difference in operation or service rendered by the use of water other than distilled? What is the effect?—R.D.R.

PLEASE SEND IN YOUR ANSWERS BY APRIL 15

SERVICE FOR ELECTRICAL SERVICEMEN

[FROM PAGE 82]

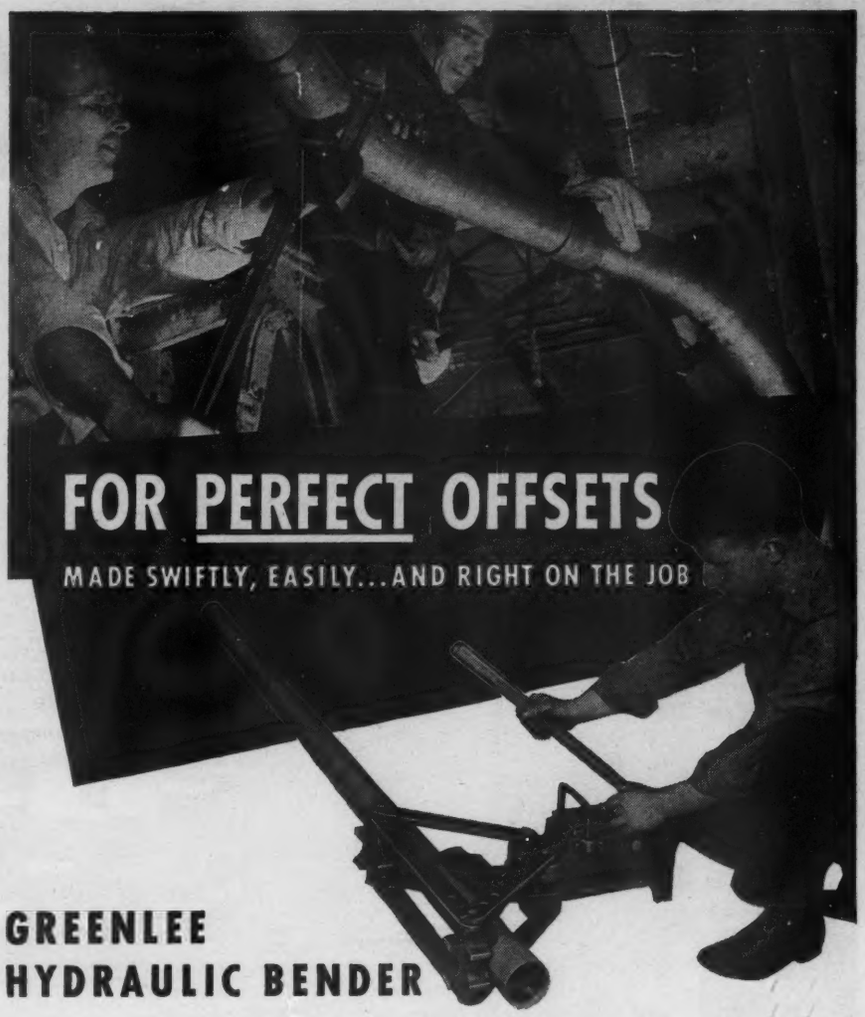
for the motor. Another typical job handled recently was a rewind job on a 600 rpm., 50 hp., d-c motor so that it could be used as a variable voltage generator to provide 1800 rpm., 35 to 380 volt, 75 kw. capacity rating.

Other work includes transformer rewinding, meter testing, a-c and d-c magnet coil repair, and variable voltage switchboards. The largest voltage job ever handled, reports Sam Heller, was an 80,000 volt transformer, and the largest motor job was a 1500 hp. motor which was rewound for different rating for the Chinese government. One recent job consisted of rewinding 150 new starters. The original rating of these starters was 25 hp., automatic 110 volt d-c, which was changed by rewinding to 220 and 440 volt, d-c rating, which automatically changed the hp. rating on each starter upward.

Work done for motor repair shops, motor dealers and electrical contractors accounts for more than 95 percent of the company's business. Many manufacturers of products destined for export, in which motors are a part of the complete product, also furnish rewind jobs for "change over" voltages and ratings on the motors.

The Heller brothers consider carefully any suggestions which might improve the efficiency of their plant, or lower production costs. The very nature of their business demands high efficiency and low production cost. The fact that they are able to do work for other repair shops at a cost lower than the repair shop can do its own work, bears testimony to the streamlined production methods and high standards used in the Consolidated plant.

Back in the motor repair field after almost three years of service in Army Ordnance is H. S. Baugh, shop superintendent of The Springfield Electric Motor Co. Inc., Springfield, Ohio.



GREENLEE HYDRAULIC BENDER

"Accuracy in offsetting is one of the big features we like in the GREENLEE Bender," reports Perry Electric Company of Hartford, Connecticut.

"On a sixty-foot tunnel job with a series of complicated bends, for example, we saved a lot of time with our GREENLEE. Compared with old methods of conduit bending and installation, the work goes six times faster," continues the report.

Let a GREENLEE make valuable time and material savings for you, too. *One man* operated to quickly produce smooth, accurate bends in pipe up to 4½", rigid and *thin wall* conduit, tubing, bus-bars. Compact, portable, easily set up. Eliminates need for many fittings and the work of installing them. And, most important, helps produce jobs of fine appearance.

Whatever your bending job, there's a GREENLEE to do it. Get complete facts on GREENLEE Hydraulic and Hand Benders. Write Greenlee Tool Co., Division of Greenlee Bros. & Co., 1743 Columbia Avenue, Rockford, Ill.

TOOLS FOR CRAFTSMEN

GREENLEE

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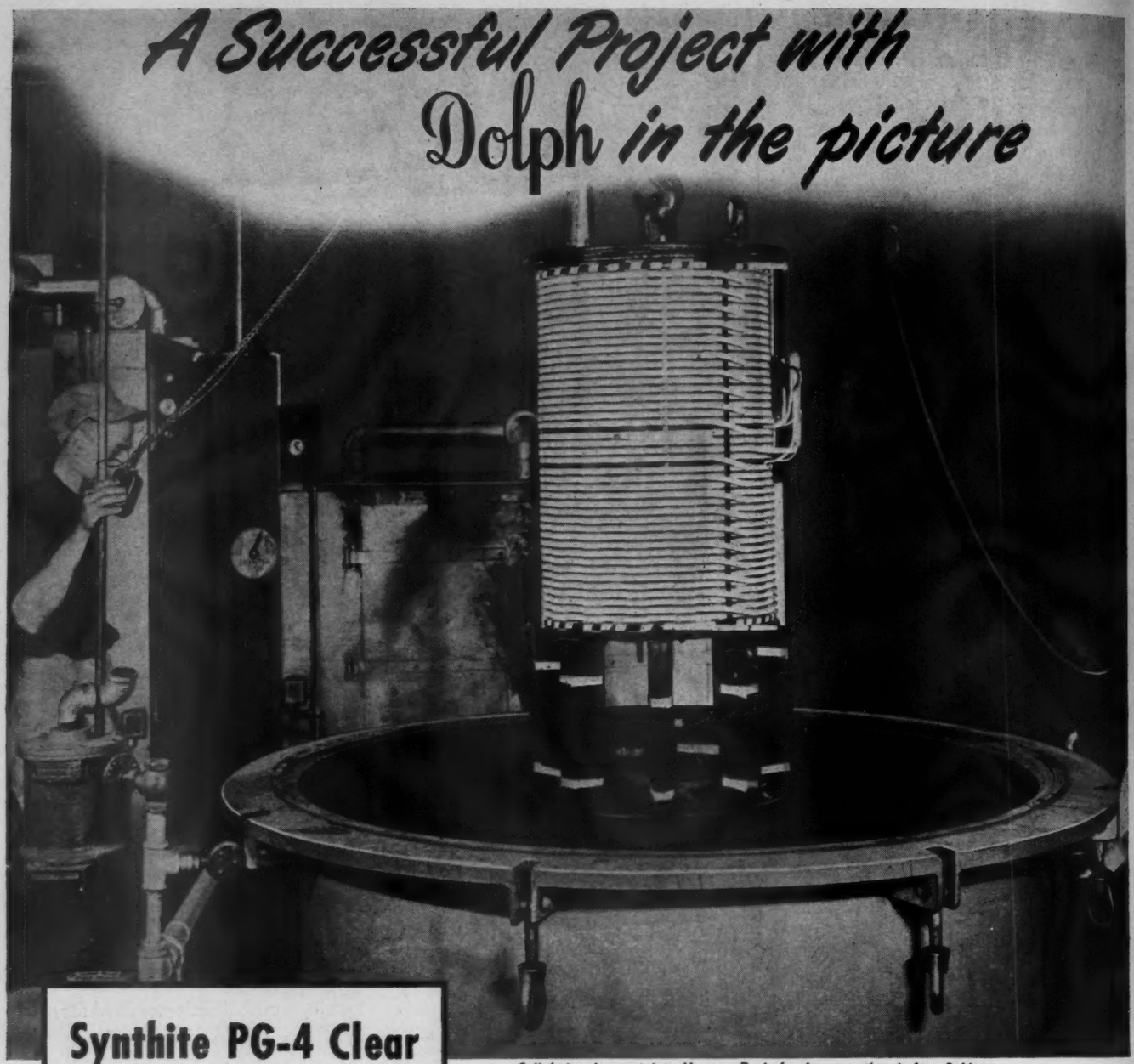
Hand Benders • Joist Borers • Cable Pullers • Radio Chassis Punches • Pipe Pushers

A Successful Project with Dolph in the picture



Coil being lowered into Vacuum Tank for Impregnation before Baking

Synthite PG-4 Clear Baking Varnish for High Temperature Resistance . . . .

Coil Held for Submersive Activity

RESEARCH problem for the Standard Transformer Company, Warren, Ohio, was to find an insulating varnish equal to this important job:

> Coils used in their high voltage transformers called for thorough impregnation to give them excellent resistance to oil and moisture and assure long service.

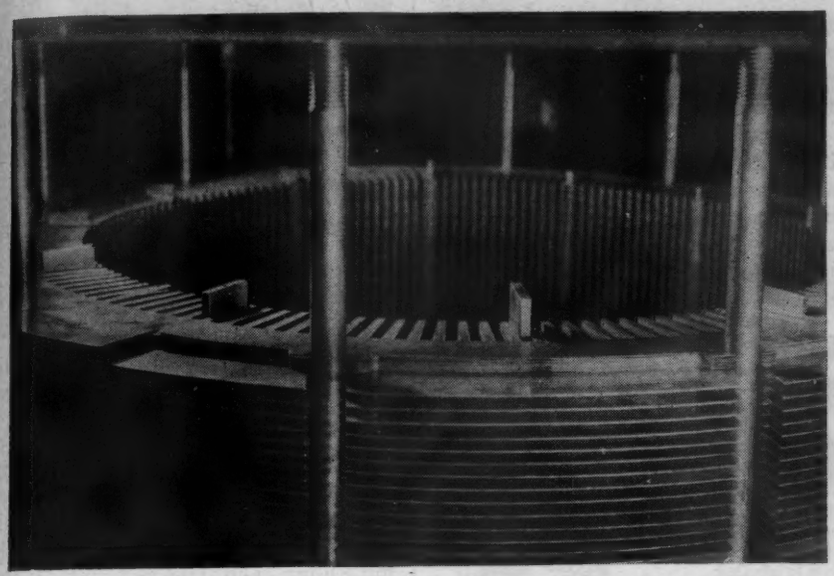
Dolph's Clear Baking Varnish (Synthite PG-4) proved equal to their requirements—gave them a plus in exceptionally high dielectric and good heat resistance.

Synthite PG-4 Clear Baking Varnish also affords maximum resistance to acids and alkalies and can be used on all types of electrical units, large and small. Cures in 4-8 hours at temperature of 275° F. Write for technical data folder on Synthite PG-4. John C. Dolph Co., 1056 Broad St., Newark, N. J.

Dolph's

INSULATING VARNISH SPECIALISTS

Motor Shops



Copper sheets which project beyond the stator are sandwiched in between magnetic iron punchings, to conduct heat away and provide increased surface for air cooling.

Copper Sandwich Aids Motor Cooling

A novel method for cooling the stators of large totally-enclosed a-c motors has been developed at the Westinghouse Electric Corporation. The method is simple, but effective. It depends on the fact that copper conducts heat about ten times better than iron.

Stator punchings are made of thin copper sheet exactly like the magnetic-iron punchings, except that they are about two inches longer at the back. These are spaced at intervals with the steel punchings giving, in effect, circular fins projecting beyond the stator iron. These copper discs are in direct contact with the iron, where the heat is generated. They therefore conduct the heat efficiently to the back of the stator, where it can be removed by air recirculated by a fan on the rotor shaft. The copper laminations go into spaces previously occupied by slots to allow for passage of cooling air, hence the total length of the rotor is actually reduced.

This copper-fin cooling system is particularly applicable to large, totally-enclosed, fan-cooled motors where the ratio of exterior surface to volume of iron is small. In small motors the ratio of surface to volume is large, on the basis that the ratio of surface to volume of a sphere decreases as the diameter increases.

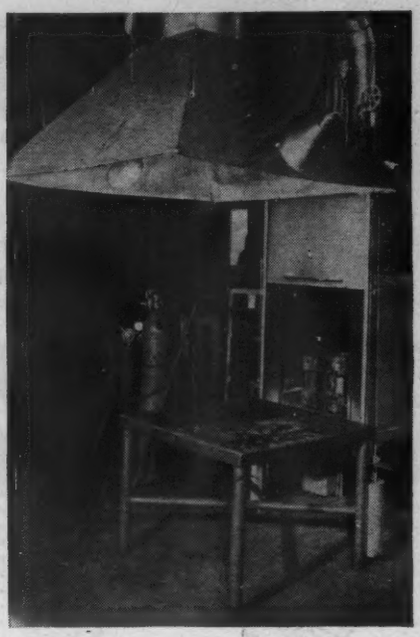
Combined Burnout Oven and Strip Table

Milford J. Walcott, shop superintendent of Price Electric Company, Columbus, Ohio motor repair firm, likes to have good housekeeping practiced in his shop. Burning out and stripping stators is one of the more unpleasant chores from the standpoint of fumes and debris. To clean up this phase of the repair routine, and to use manpower more efficiently, he designed a totally enclosed burnout oven; placed the stripping table in front of it under high intensity lighting.

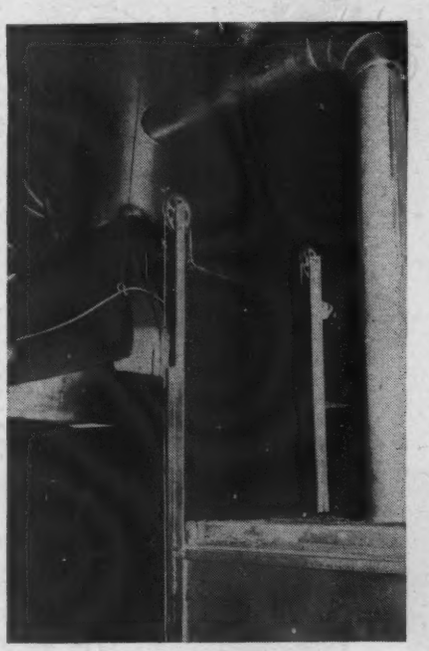
The oven is constructed of 1-inch angle iron frame to which is welded a sheet steel enclosure. Standing 24-inches above floor level, the 30-in. by 30-in. by 30-in. (outside dimensions) unit is lined with one course of fire brick; is fired by two rectangular natural gas burners; has a counterweighed sliding door made of $\frac{3}{8}$-in. boiler plate.

Base of the oven, over the burners, consists of a $2\frac{1}{2}$-in. angle iron frame with 3-inch channel on each side. Two sections of $2\frac{1}{2}$-in. angle slide laterally on the base to support stators of various diameters. The close fitting door slides up and down in grooves formed by two lengths of angle iron welded to the oven frame. Cylindrical cast iron weights are connected to the door by steel aircraft cables going over aircraft runaround pulleys (ball bearing centers). Perfect counter-balance is obtained permitting the door to be raised to any desired position.

Directly in front of the oven is a 3-ft. square stripping table made of



New burnout oven with stripping table and exhaust hood designed and installed by shop superintendent M. J. Walcott at Price Electric Co., Columbus, Ohio.



Closeup of oven door support and counterweight pulleys (ball bearing centers). Note oven duct connection to stripping table exhaust duct.

A Complete Line of Electrical Fittings!

Malleable Iron means a lot in reducing installation time!

ASK YOUR WHOLESALER! Smooth fit—that can be the difference between just breaking even and good profits on a job. No wasted time forcing or cleaning obstinate fittings. GEDNEY Fittings *fit* . . . because they're made of high grade malleable iron. They have smooth finish inside and out, with clean, accurate threading. Next time, start your wiring job right—install GEDNEY Fittings.

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CONDUIT NIPPLES

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GROUND FITTINGS

SQUEEZE CONNECTORS

EMT 90° ELBOW CONNECTORS

WRITE FOR THE 62-PAGE GEDNEY CATALOG!

It's all there—every GEDNEY item clearly indexed, with every size and type for your job. This manual will save you plenty of time because it has been made up to give you information . . . fast! Send for your copy; write on company letterhead.

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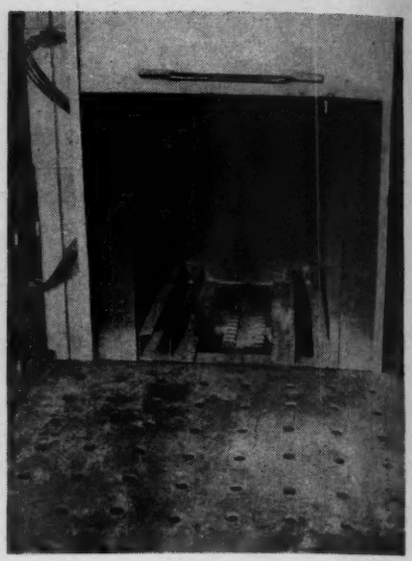

Interior view of burnout oven showing movable rails, gas burners and stripping table in foreground.

⅜-in. boiler plate welded to a 2-in. angle iron frame. Facilities for anchoring stators during stripping are provided by 64 1-in. holes in the table top. Four 2½-in. pipe legs support the table at oven height; permit sliding of stator from oven to table with least effort.

Fumes are effectively removed by a carefully designed exhaust system. Directly over the stripping table is a 5-ft. square sheet metal hood equipped with two 200-watt incandescent bowl reflectors. Mounted on opposite sides of the hood, these units project ample illumination on the stripping table. The oven exhaust duct is tied in to the main duct above the hood, as is a duct from a metal spraying lathe nearby. A single fan, powered by a 1½-hp., 220-volt, 3-phase, 1800 rpm. motor, serves all three ducts which are equipped with manually operated dampers to control degree of exhaust.

Up to 15-hp., 1800 rpm. stators can be burned out in this oven. Normal burnout time varies from one-half to one hour depending upon the condition of the coils. Oil impregnated coils burn faster, dry ones slower.

Takes Paper Cutter to Job

Melvin E. Vaughan, Sr., of the Vaughan Electric Service, Los Angeles, noticed that operators in preparing to cut papers or cardboard for insulation, must necessarily go at it by the cut-and-try method, to get the pieces of exactly the right size. This usually means several trips to the paper cutting machine, which might be anywhere from 50 to 100 feet from where

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For Underground Use

● **CRESCENT IMPERVEX TRENCHWIRE provides the LOWEST COST, PERMANENT underground installation for services from power line to meter, for connecting several buildings from the same service, as on FARMS, ESTATES and INSTITUTIONS and for STREET, AIRPORT, BALL PARK and other outdoor lighting and power circuits.**

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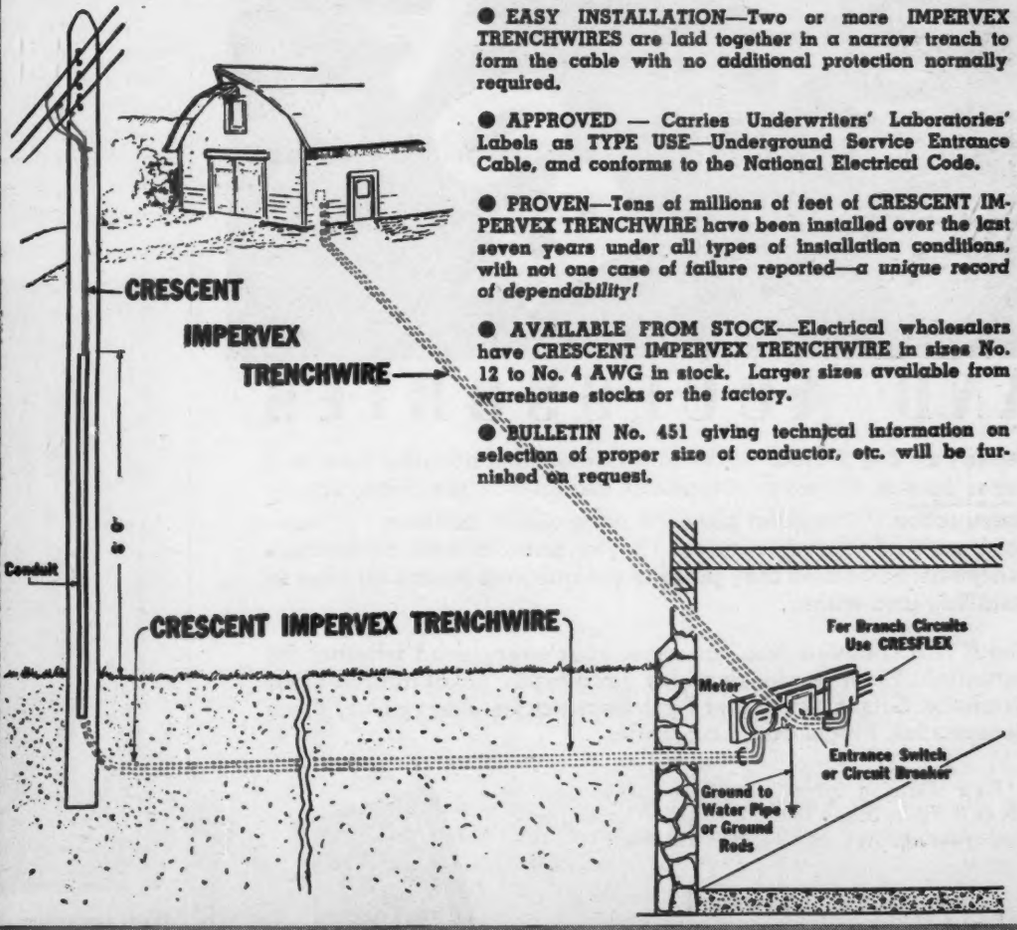

● **EASY INSTALLATION—Two or more IMPERVEX TRENCHWIRES are laid together in a narrow trench to form the cable with no additional protection normally required.**

● **APPROVED — Carries Underwriters' Laboratories' Labels as TYPE USE—Underground Service Entrance Cable, and conforms to the National Electrical Code.**

● **PROVEN—Tens of millions of feet of CRESCENT IMPERVEX TRENCHWIRE have been installed over the last seven years under all types of installation conditions, with not one case of failure reported—*a unique record of dependability!***

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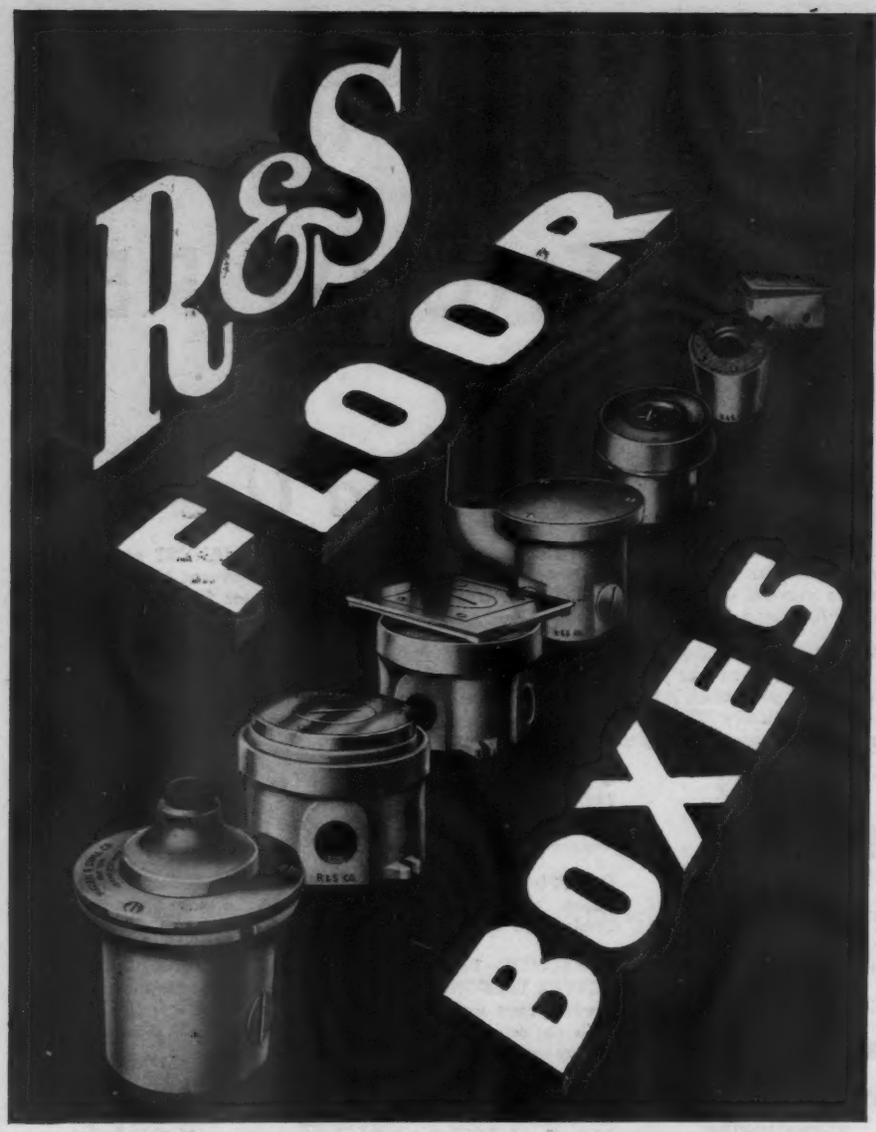

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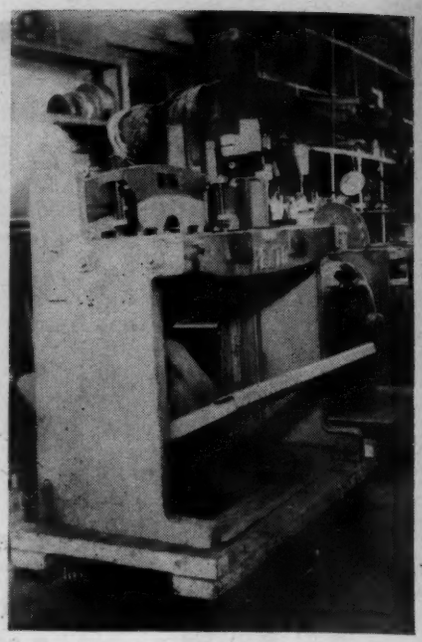

Paper cutter on casters.

the winding was being done. Taken month in and month out, this represents a very definite loss of time.

Therefore, Mr. Vaughan had the paper cutter mounted on a castered platform, so that the operator can readily roll the machine to the place where it is needed, making only one trip. Since the machine is operated by a foot treadle, there is no problem of power connections.

Wall mounted growler takes minimum space in the motor repair shop of Reliable Electric and Equipment Company, Zanesville, Ohio. Counterweighted growler slides up and down in wooden frame bolted to shop wall; has vertical travel of 18 to 24 inches. Unit can be positioned to fit any stator (up to 50 hp. size) mounted on portable jack for testing. Simple steel cable and pulley arrangement tie weight to growler.

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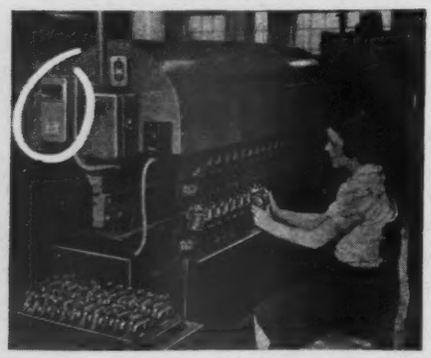
Let this GE Time Switch Save You Money!

Type T-27 helps reduce waste .... increase profits

Guessing at the timing of industrial processes often results in waste, poor quality, and loss of time and money. By letting the General Electric T-27 time switch handle these jobs you can prevent losses and help lower manufacturing costs. And lower costs mean added profits.



Here a T-27 controls movement of a chain conveyor through an electric oven —one of a complex cycle of time-switch-controlled operations in the manufacture of meter coils.

The T-27 is a versatile time switch equipped to handle a variety of jobs. Use it to turn ovens "on" and "off" at exactly timed intervals . . . to operate ventilating fans and blowers . . . to turn heating units on early so that they will be ready for use when workers arrive. Or let it control drying and curing processes after hours, without the attention of an operator.

It can do these and dozens of other timing jobs for you tirelessly and efficiently. It is a COMPLETE time switch . . . "complete" in that it is designed to handle almost any type of time-control assignment. Put the T-27 to work for you and benefit from the added economies. Ask the nearest G-E Office for further information, or write for Bulletin GEA-3339. *Apparatus Department, General Electric Company, Schenectady 5, New York.*

GENERAL ELECTRIC

603-49

Dynamometer Gives Positive Motor Check

When a damaged motor has been repaired or rebuilt in the Easton, Pennsylvania, shop of the H. N. Crowder, Jr. Company, it is positively checked before being delivered to the customer. Actual working conditions are created with a dynamometer which quickly and accurately indicates the operating characteristics of the unit being tested. In this way, there is little doubt that the motor, when delivered, will not perform the task for which it is intended.

Delco motor is tested by dynamometer in Easton, Pennsylvania, shop of the H. N. Crowder Jr. Company before delivery to customer. Testing machir indicates rpm., ft. lbs., watts, a-c d-c volts and amperes. Panel minated by fluorescent lightin ture. Testing platform may bc or lowered to desired height crank.

Recording instruments show consumptions under various overloading capabilities and ing and running torques.

Pictured in the illustratio third hp. Delco motor is b jected to a thorough check b approval at the shop. Mot tested are placed on the tes form which can be raised o by turning the hand crank s neath the table. A yoke and shaft support the cast cradle lowered and tightened to rig the motor on the table. The aligned with a universal chuck t receive the shaft of any motor the range of the dynamometer. front of the dynamometer cab indicating dials to register foot- d-c volts, d-c amperes, watts, a a-c amperes and revolutions p ute. Instruments are illuminate above by a suspended fluorescen

Answered by
F. N. M. SQUIRES and GLENN ROWELL
New York Board of Fire Underwriters
Chief Inspector
New York, N. Y.
Electrical Engineer
Fire Underwriters Inspection Bureau
Minneapolis, Minn.

Questions on the Code

Neutral Fusing

Q. *Does the 1947 Code require or recommend that a fuse be placed in each conductor of a two-wire unpolarized existing 120 volt 15 amp. lighting circuit when such a circuit is connected to one side and the neutral of a 120-208 volt three phase 4 wire solidly grounded neutral system?*

Our local Inspector claims two fuses are required by Section 2409 Paragraph B of the Code. I understand that Section 2409 Paragraph C of the 1940 Code which has been deleted from the 1947 Code required double fusing but cannot find any direct reference to it in the latest code.—R.W.L.

A. The 1940 Code, as had many previous Codes, required that both wires of a two wire branch circuit of an unpolarized system, be fused unless all of the lampholders on the circuit had the screw shells connected to the grounded conductor. (Note that this unpolarized system, did have a grounded conductor).

This provision was deleted from the 1947 code so that this requirement is no longer mandatory nor does the 1947 code recommend it.

Some inspection authorities however, still do make it mandatory to fuse both wires of such circuits unless the lampholders and sometimes the switch legs have been polarized by proper connections to the grounded conductor.

Other authorities maintain that a fuse in the neutral is a definite hazard. —F. N. M. S.

Insulating Bushing

Q. *On a rewiring job we are bringing four No. 350,000 CM Type RH conductors through a 3½ inch conduit which terminates behind a standard switch board. Where these conductors leave the conduit, is it necessary to bring each conductor through a separate hole in an insulating terminal fitting or may I use an ordinary bushing?*—A.R.V.

A. You may use an ordinary insulating bushing. The Code does not require the use of a terminal fitting having separate openings for each conductor where the conduit terminates behind a switchboard. You may find this ruling under Section 3009 of the Code. You will note that whenever four or more conductors leave the conduit at control apparatus, the conductors must be bunched, taped and painted with an insulating paint. Under the preceding section you will note that the terminal fitting having separately bushed holes for each conductor must be used wherever a change is made from conduit, electrical metallic tubing, nonmetallic sheathed cable, armored cable, and surface metal raceway wiring to open or concealed knob and tube wiring.—G.R.

Parkway Cable

Q. *Can Parkway cable such as 3 wire RLJFJ be brought straight into main switch boxes or into distribution boxes with main disconnect included. What connectors are used here and at junction boxes etc.? Can lead sheath be used as neutral in two wire cable for service entrance? Can these cables be imbedded directly in concrete or masonry as it comes in from the underground? Can they be laid entirely in concrete floor as a branch feeder?*—H.T.I.

A. The Code does not mention the name "Parkway Cable" nor does Underwriters' Laboratories have a listing for cable under this name, Neither the Code nor the Laboratories' List mention the designation "RLJFJ".

Inspectors in general must rely on Underwriters' Laboratories' Listing for their approval of electrical materials and expect to approve only such items as are mentioned in the Code and are listed.

Service entrance cables are mentioned in the Code and are listed by the Laboratories so if manufacturers desire to have inspectors recognize cable such as "Parkway Cable" and to approve its use under the Code rule, they should have it listed as an appropriate type of service entrance cable.

Parkway cable is no doubt, good cable for underground use and probably could be listed as service cable if so submitted.

If then, it was listed as service cable, it could be brought directly into the main service switch box, whether the service switch box also contained the branch circuit overcurrent devices or not.

Several manufacturers have connectors listed for use with service entrance cable.

The lead sheath of a cable *cannot* be used as a neutral conductor nor can a steel armor be so used.

Types ASE and USE service entrance cables, may be imbedded in concrete or masonry as they enter buildings in service runs.

The Code permits Types SE & ASE cables to be used for interior wiring if *all* of the conductors are rubber covered or of the thermo-plastic type but these two types should not be buried in concrete.—F. N. M. S.

Fused Switch

Q. *Does the Code require the use of a fused switch as the disconnecting means when that switch is mounted near the motor control switch which is provided with fuses?*—H.M.R.

A. You neglected to state the horsepower of the motor involved. It is possible you will find the answer to your question under Section 4407, which reads as follows: "A switch or circuit breaker complying with the provisions of Section 4383 may serve as both controller and the disconnecting means if it opens all ungrounded conductors to the motor, is protected by an overcurrent device

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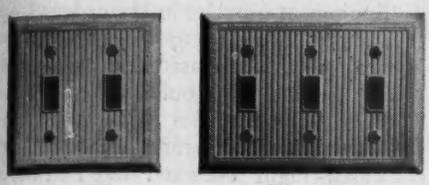
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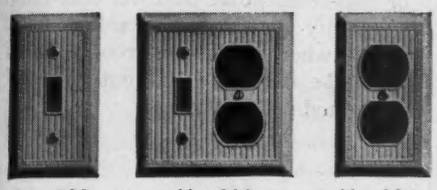
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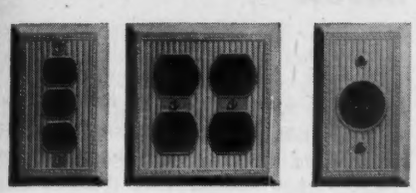
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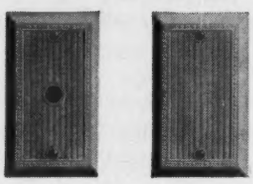
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(which may be the branch circuit fuses) which opens all ungrounded conductors to the switch or circuit breaker, and is of one of the following types:

(a) An air break switch, operable directly by applying the hand to a lever or handle.

(b) A circuit breaker operable directly by applying the hand to a lever or handle.

(c) An oil switch used on a circuit whose rating does not exceed 600 volts or 100 amperes, or on a circuit exceeding this capacity if under expert supervision and by special permission."

Then in a fine print note following this section you will note that the oil switch or circuit breaker can be both power and manually operable. If it is power operable, it must be designed so it may be locked open. The overcurrent device may either be part of the controller assembly or a separate unit. Whenever a compensator type of controller is used, a separate disconnecting switch must be provided.—G.R.

Farm Wiring

Q. *A new superintendent for the REA has insisted that we supply a driven ground for the neutral for each chicken or hog house on every farm. Is this required by the Code?*—M. A. S.

A. Yes, the Code under Section 2524 requires such grounds. You will find this section to read as follows: "If more than one building is served by the same service, the grounded circuit conductor of the wiring system in any building utilizing one branch circuit supplied from such a service may be connected to a grounding electrode at such building, and in the case of any building utilizing two or more branch circuits supplied from such service, and in the case of a building housing livestock, shall be so connected." Therefore a hog house with only a single lighting outlet will have to be grounded to conform to Code standards.—G. R.

Explosion-Proof Versus Others

Q. *Please specify the difference between weatherproof fixtures and outlets and explosion-proof fixtures. There are fittings to insert in pipe with compound. Outside of that,*

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RUGGED TUBULAR BRIDGE
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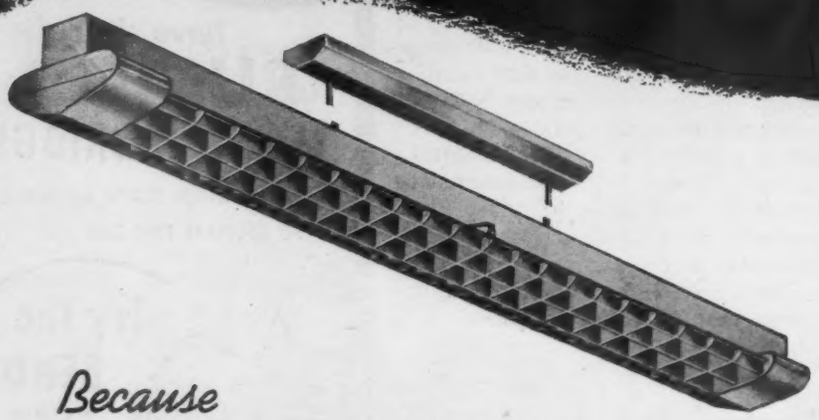

Because they give complete customer satisfaction with your job—both now and later. 10,000 hours lamp life expectancy means lower maintenance cost—lack of intermediate burn-outs—no replacing lamps during working hours. Complete absence of flicking; practically no deterioration throughout the entire life of the tube.

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how can the difference be definite?—J.A.H.

A. Explosion-proof fixtures are built to be capable of permitting an explosion to occur within the fixture without the explosion communicating fire to the outside of the fixture.

Such fixtures must be marked in accordance with the markings given in the Underwriters Laboratories "List of Inspected Electrical Equipment" under "Equipment For Use in Hazardous Locations". The same applies on all electrical equipment used in hazardous locations including outlet boxes.

The Laboratories do not list "Weatherproof Fixtures", but do list "Vapor-Tight" ones and state that they are suitable where exposed to moisture or non-combustible dust but that their suitability for use in hazardous locations (where explosion-proof fixtures would be required) has not been investigated.—F.N.M.S.

Screw Sizes

Q. *On knob and tube jobs I know that the Code requires that the nails used to hold the knobs be not smaller than tenpenny. I want to use brass screws on the cattle barn jobs so they will not rust off. Does the Code require a certain size screw?*—F.L.A.

A. Yes, Section 3204c states that when screws are used, they shall penetrate the wood to a depth of at least one-half the height of the knob and/or the full thickness of a cleat. When using screws to support porcelain knobs or cleats in buildings housing livestock, they must never be set up tight as the wood to which they are fastened will expand during early spring and will break the porcelain unless there is expansion room left by the person attaching the knobs or cleats.—G. R.

Abuse of Armored Cable

Q. *Would it be a violation of the Code to remove the wires from BX cable and substitute two Type T conductors? The object being to install different colored circuits to solenoid valves and control switches from a relay channel.*—W.J.S.

A. It surely would be a violation to pull the wires out of armored

cable and then to pull other wires into the empty armor. If the desired color scheme is not available why not use some colored paints on the ends of the wires after testing them for the right continuity?—F. N. M. S.

Grounding

Q. *Several years ago I sold and installed a milking machine. Recently the motor shorted out charging the motor frame and my customer was quite seriously injured as he fell striking his head when he received a shock. Upon investigating I found my grounding wire and rod still in place, the motor circuit was protected by 15 ampere fuses of the tamper proof type and they did not open. Can you explain the reason for approved fuses failing to open?*—H.T.S.

A. The use of a driven ground rod in no way assures low resistance grounding. The Code under Section 2584 states that the resistance to ground shall not exceed 25 ohms. If the resistance on the ground rod this motor was grounded to was 20 ohms, only 11½ amperes of current would flow if the motor operated at 230 volts and was directly shorted to the grounding rod, or if only a 115 volt motor was involved only 115/20 or 5¾ amperes would flow and in either case such a short would not open a 15 ampere fuse. Sometimes it is not possible to obtain resistances as low as 20 ohms with a single driven ground rod, in fact during dry spells few driven ground rods will have that low a resistance. If an actual measurement of the resistance to earth on the ground rod you have used indicates that the resistance is 25 ohms or less, you have complied with the Code but the installation is still a possible hazard.—G.R.

Gil Stadeker (left), lighting engineer, Triangle Electric Co., Chicago, uses paper and pencil to analyze his discussion with R. A. Morrison, Chicago electrical engineering consultant.

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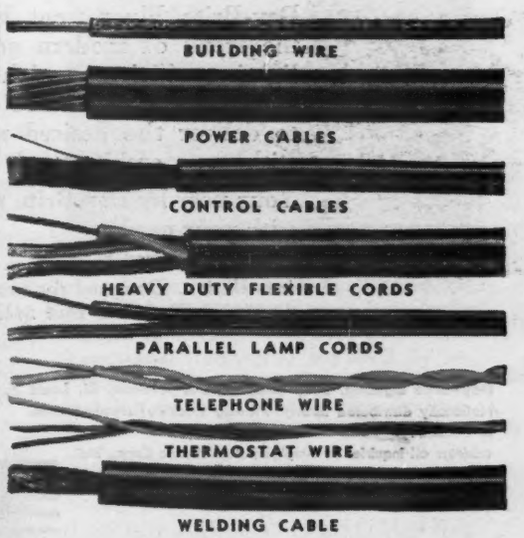

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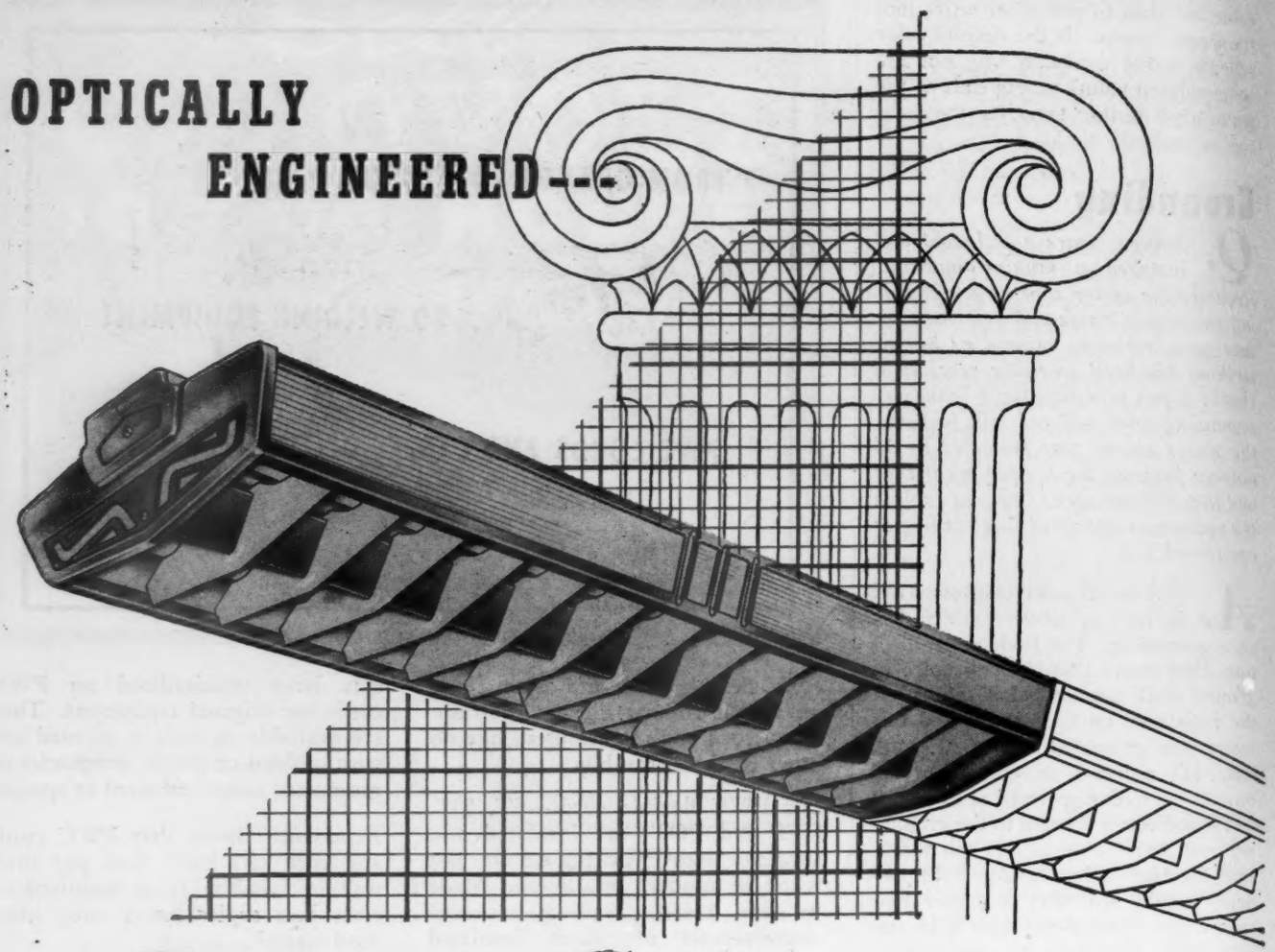

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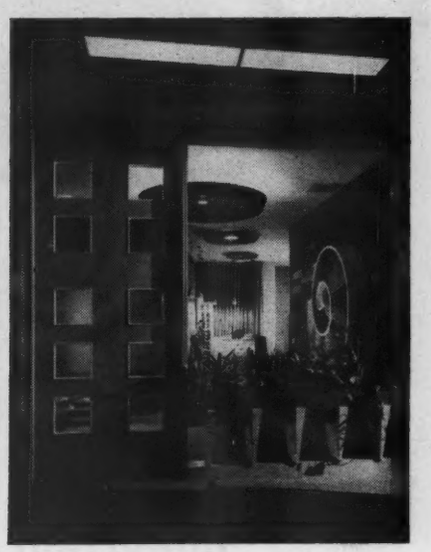
Modern Lighting

Dropped ceiling, above lounge area, telephone switchboard and fabric displays, is pierced by series of round recessed diffusing-lensed floodlights. Surface-mounted bullet spots are noticed over special display in background.



Looking through glass partition between reception area and carpet showroom, several lighting treatments are apparent. Recessed fluorescent units illuminate floral displays in foreground. Suspended fixture, combining cold-cathode cove construction and central incandescent spotlight, is seen opposite wall pinwheel. Suspended swivel bullet spots illuminate special display in background.

Dramatic Lighting Promotes Wool Products

That modern lighting is a decorative tool as well as a source for functional illumination is again emphasized in the ultra new yarn and carpet showrooms recently completed in Chicago's Merchandise Mart Building for the James Lees and Sons Company. The smart lighting arrangements, architectural designs, interior decoration and swank furnishings are all creations of Raymond Loewy Associates, outstanding industrial designers.

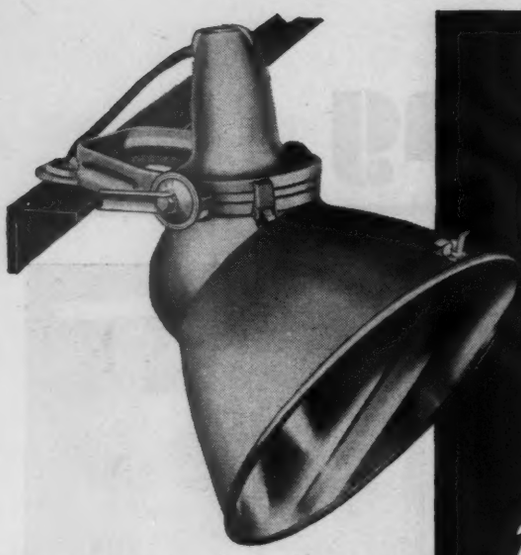
Interesting techniques in wholesale yarn showroom designs have been employed to most effectively present the merchandise. Since the riot of color, inherent in the woolen balls, skeins and finished products, supplies a dramatic decorative theme, all background colors, including walls, carpeting and furnishings, are neutral shades. With backgrounds subdued, two features become outstanding; the colorful products themselves, and the planned lighting which gives life to these products.

Lighting is both incandescent and fluorescent, direct and indirect, recessed and suspended. Attractive wall cases in the foyer are top-lighted by fluorescent cove strips, while immediately inside the open glass entrance, a tremendous wall pinwheel display, containing balls of yarn in a graduated color arrangement, is strikingly illuminated by a suspended direct-indirect fixture. This large, circular fixture combines cold cathode cove construction around the circumference and a central recessed spotlight. The cove lighting softly illuminates the white ceiling while the spot directs high-intensity light to the receptionist's desk of oak topped with white Textolite.

Flanking the reception area are entrances to two showroom sections displaying yarns and carpets. Doors of oak open through floor-to-ceiling glass partitions bordered by attractive floral box arrangements. These entrance areas are illuminated from above by 4-lamp 40-watt fluorescent units, recessed into the ceiling and panelled by diffusing opal glass.

In the carpet showroom, large circular cold-cathode cove-lighted domes are regularly spaced over the center line of a broad carpeted aisle. Recessed into the ceiling between these domes are circular, louvred, conditioned-air diffusers. Paralleling this center-line arrangement is a row of square, recessed, diffusing-lensed incandescent floodlight units, adding warmth and color correction to the

Broad, carpeted aisle in carpet showroom area is decoratively illuminated by series of circular domes, indirectly lighted by cold-cathode cove treatment. Functional lighting is supplied by recessed square-lensed floodlights. Highlighting is accomplished with surface-mounted spots.



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750 or 1000 watts, Type L-31	GEA-4305
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1000/1500 watts, Type L-34	GEA-4517
200 or 250 watts, Type L-38	GEA-4325
General purpose, sheet aluminum	
300 or 500 watts, Type L-49	GEA-4311
750 or 1000 watts, Type L-43	GEA-4310
Sports and area, sheet aluminum	
750 to 1500 watts, Type L-68	GEA-4333
750 to 1500 watts, Type L-69	GEA-4590
Area, open porcelain enamel	
300 to 1500 watts Type L-45	GEA-4433
300 to 1500 watts Type L-46	GEA-4434
Handy, sheet aluminum	
100/150 watts, Type L-65	GEA-4516
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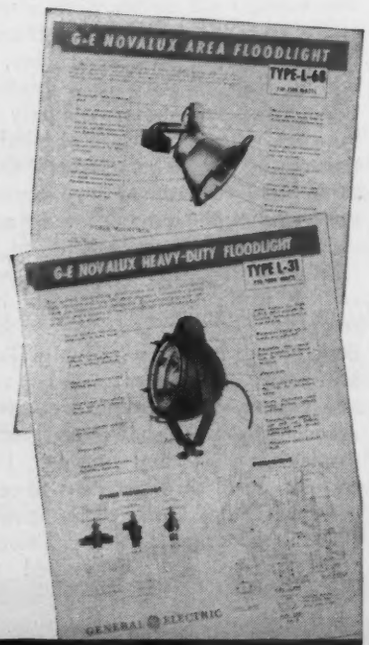
Order individually by number, or in sets, from the G-E Apparatus Sales Office or Agent that serves you. Or write General Electric Company, Schenectady 5, N. Y.



GENERAL ELECTRIC

Square, diffusing-lensed incandescent floodlight units are mounted singly or in combination with recessed fluorescent 4-lamp 40-watt fixtures shielded by opal glass panels. Square housings over carpet racks in rear contain concentrating spotlighting lenses.

rich fabrics. With the exception of eight hanging swivel bullet spotlights and a few surface-mounted units of similar design, all lighting is recessed to emphasize the smooth sweep of the show areas. Suspended fixtures are used only for highlighting special displays of hand loomed fabrics.

Over several show areas, normal ceiling heights are reduced through the decorative medium of suspended structural canopies. Where this occurs, dropped ceilings are pierced by series of round diffusing-lensed floods. Combining these mentioned fixtures in various combinations has resulted in a lighting plan that is functional yet vitally modern.

Modern design is also apparent in the furniture and furnishings. Display units are constructed of oak and clear plastics with white and grey enamel color accents. Wall surfaces are predominantly grey-green while carpeting is grey-beige. Accents of terra cotta are found only where they do not compete with the color of the merchandise. Ceilings are white. Seating units are richly upholstered in brown and olive drab in addition to the background colors of terra cotta and grey-beige. Simply designed and boldly illuminated, the showrooms are smart, dramatic and definitely effective in promoting sales.

Driveway Units Designed for Beauty

In constructing a new research laboratory, the Air Reduction Sales Company was largely influenced in the designs by their location which was in a semi-residential section of New Providence, New Jersey. For this reason, shops and labs as well as office

Curtis TROFFERS

...DID THE COMPLETE JOB!

FROM CAFETERIA TO CONFERENCE ROOM

When the Chicago Title and Trust Company planned its move into new and larger quarters, the selection of the lighting system presented a major problem. Specifications called for efficient seeing conditions, plus modern streamlined appearance. The lighting job involved general offices, private offices, executive offices, corridors, the conference room and the cafeteria.

All lighting specifications were met and uniformity of appearance was maintained by the use of approximately three miles of Curtis Troffers, installed according to requirements of the individual lighting problems. Glass bottom troffers were used in some areas, louvered troffers in others. The majority of the units were the efficient and economical 2-40 watt units. But . . . regardless of the requirements of individual areas . . . regardless of style . . . the significant fact is the job was completely lighted by Curtis!

Write for condensed Catalog 47 which contains complete data on Curtis Troffers and other Curtis commercial lighting equipment.

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Switch blade assembly which includes positive aligning guides, functioning also as arc suppressors.

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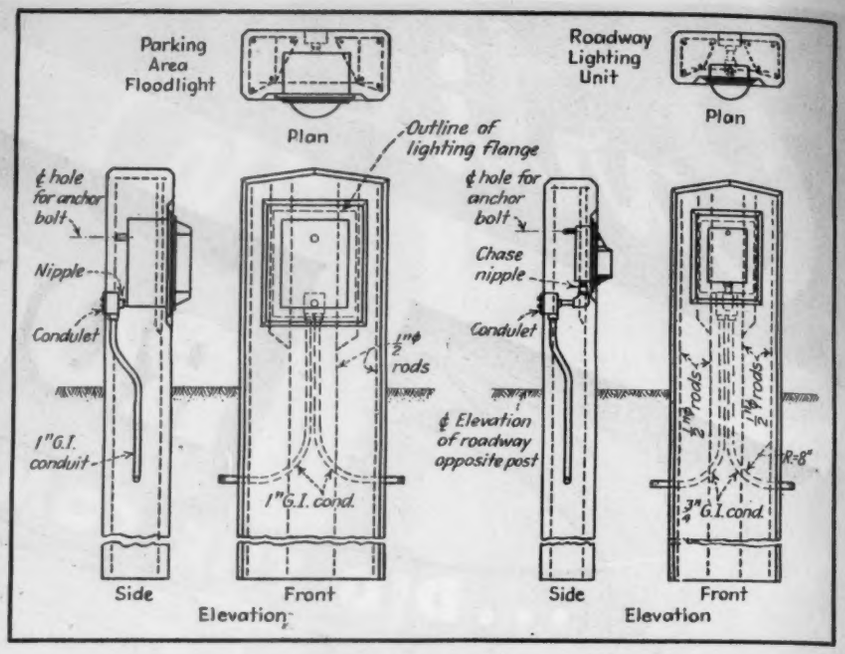


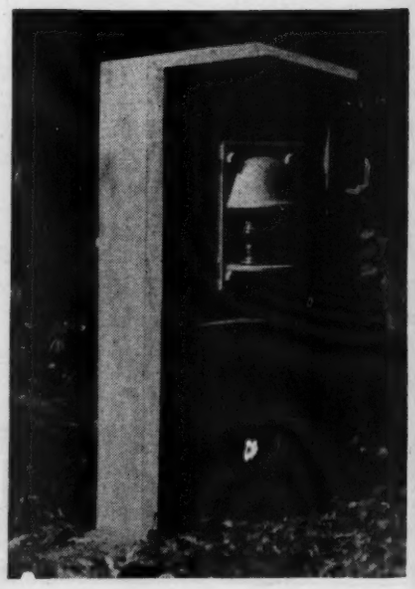
Construction includes reinforced concrete pedestals, galvanized iron conduits sweeping from underground service lines to lamp housings, condulets, Crouse-Hinds aluminum lighting units, wide spread floodlight lenses and ornamental frames. Controls for outdoor lighting circuits are inside new laboratory building.

and administrative quarters are designed with modern simplicity. Industrial designing is subdued wherever possible, even to the outdoor lighting units for parking areas and driveways. In this manner, the research center presents a well-deserved impression of dignified simplicity and good taste.

Two lighting units were designed by the Wigton-Abbott Corporation to provide adequate lighting along driveways and loading areas. Units are less than 3½ feet in height above grade, lamps are 100 or 200-watts depending upon function and location, and lenses are horizontal-spread floodlight type.

Moulded pedestals are 28-day 2500-pound concrete, reinforced both horizontally and vertically 2-inches beneath the interior concrete surface. Galvanized iron conduit provides cable runs so that lamp housings can be serviced by the No. 12 RW cables that connect the units and are buried at least 18-inches below grade. Lighting units are Crouse-Hinds. Housings are cast aluminum.

The units are attractive, sturdy and effective. Maintenance is simple since ladders are not necessary to reach the assemblies. A single man can perform the necessary cleaning and relamping unassisted and in safety.



Reinforced concrete pedestals mount driveway and parking area floodlights in attractive and effective setting. Horizontal-spread lenses keep illumination close to ground over wide area. Underground circuits feed units. Controls are located inside recently-completed laboratory buildings.

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That educate your customers on the importance of *complete* lighting.

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View of main aisle inside tire plant, showing Miller Company's 50 Foot Candler fluorescent lighting system. Each continuous row of reflectors is 900 feet long, with 90 double reflector units, each with four 40 watt lamps. Intensity is 25 foodcandles average on work plane.

Fluorescent Lighting In South Africa

Reminiscent of the wartime industrial plant lighting in the United States is the fluorescent lighting installation recently installed in the Goodyear Tire & Rubber Company plant in Uitenhage, South Africa. The size of the plant, and the type of equipment, including layout, are quite similar. The plant is several hundred feet long, and typical one-floor construction. The lighting system consists of rows of 2/40 watt industrial porcelain enameled steel reflectors installed end-to-end on continuous wireway.

An average intensity of 25 footcandles is obtained in this large plant. Producing this uniform intensity is the Miller Company's "50 Foot Candler" fluorescent lighting system, but with wider spacing and higher mounting height than is used for the 50 footcandle intensity. Double reflectors, each containing four 40 watt fluorescent lamps, are installed on the continuous wireway channel on approximately 10-foot centers. These continuous rows are installed approximately 18 feet from the floor on 12½-foot spacings.

This huge tire plant comprises many departments and types of operation. The same type lighting is used throughout, however, with the same mounting height and spacings in all areas. This provides the same uniform lighting quantity and quality in all parts of the plant, regardless of type of work done. Use of the one system and one type of equipment simplifies maintenance, and minimizes the replacement parts stock required for maintenance and repair, an important consideration when using an imported product involving unavoidable delivery delays.

Lighting An Electrical Showroom

Three distinct types of lighting are used in the new store and office recently completed for the Kansas City Power and Light Company. The first is a gyro spot which may be rotated at a 30-degree angle or directed downward for emphasis lighting. The second type is an indirect incandescent system built into the ceiling and designed for overall illumination. Lamps are bowl-silvered, supported in pendent-mounted aluminum housings and shielded by shallow saucers of decorative glass. Each lamp is suspended in the center of a large dome recessed into the normal ceiling. Since pendents are the same depth as the domes, the glass saucers are suspended at the normal ceiling elevation and the effect is spacious. The gyro spots and air diffusers are also recessed, resulting in a ceiling clear of all protrusions. The third type of lighting is high-intensity, fluorescent, instant-starting and deeply louvred. With a steep cut-off angle, source brightness and resulting direct glare are absent.

Several objectives were achieved with this combination. Maintenance and depreciation are low. Intensities are high while even distribution and glare elimination produce maximum

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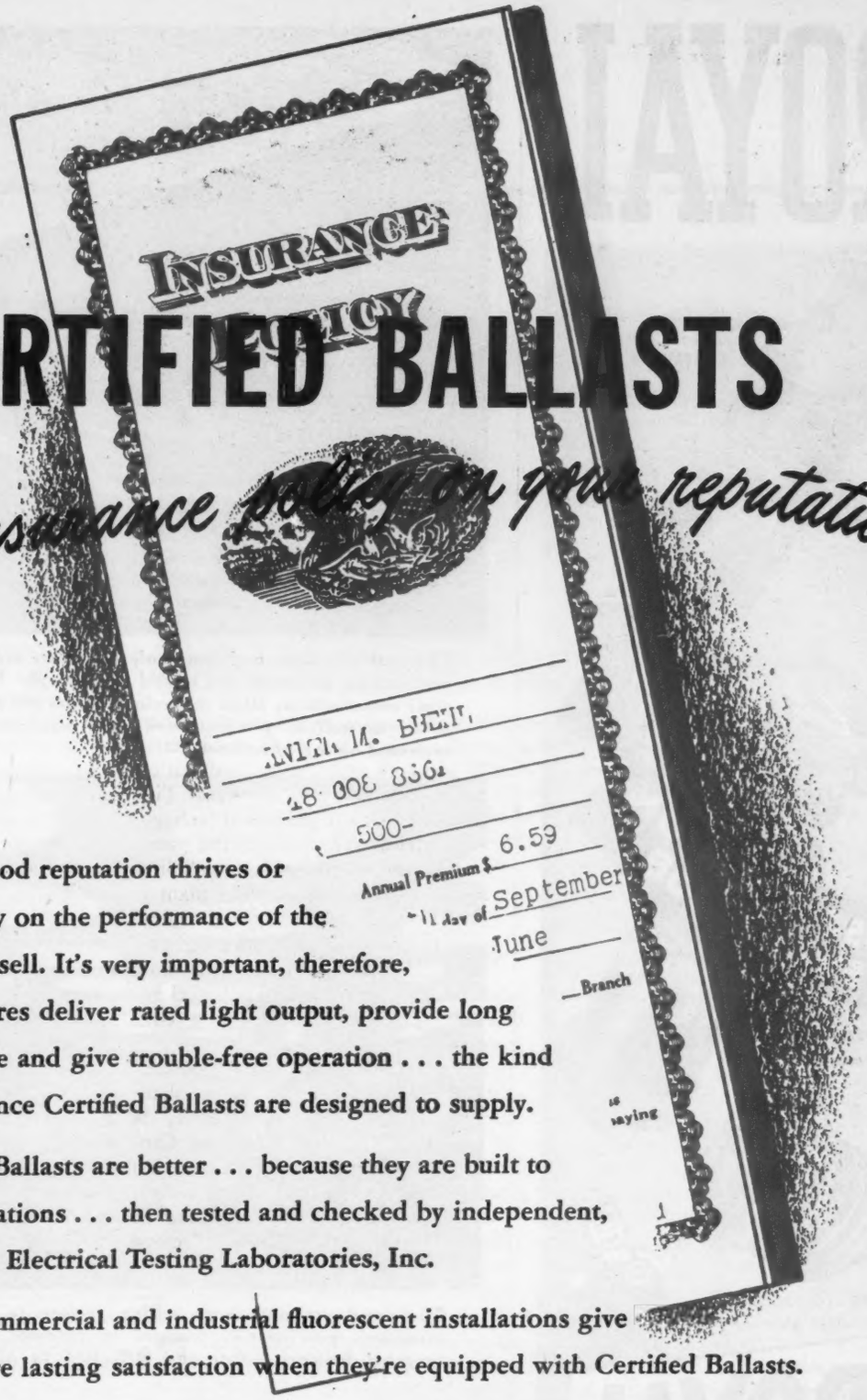
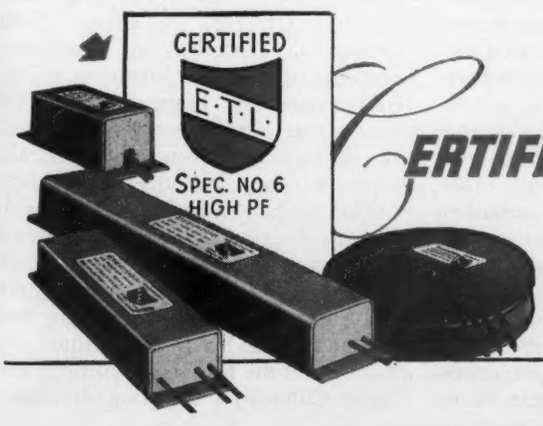
are an insurance policy on your reputation



Your good reputation thrives or falters largely on the performance of the fixtures you sell. It's very important, therefore, that your fixtures deliver rated light output, provide long lamp life and give trouble-free operation . . . the kind of performance Certified Ballasts are designed to supply.

Certified Ballasts are better . . . because they are built to rigid specifications . . . then tested and checked by independent, impartial Electrical Testing Laboratories, Inc.

That's why commercial and industrial fluorescent installations give more lasting satisfaction when they're equipped with Certified Ballasts.



• *All Fleur-O-Lier fixtures and Certified Lamps with circline tubes have Certified Ballasts.*

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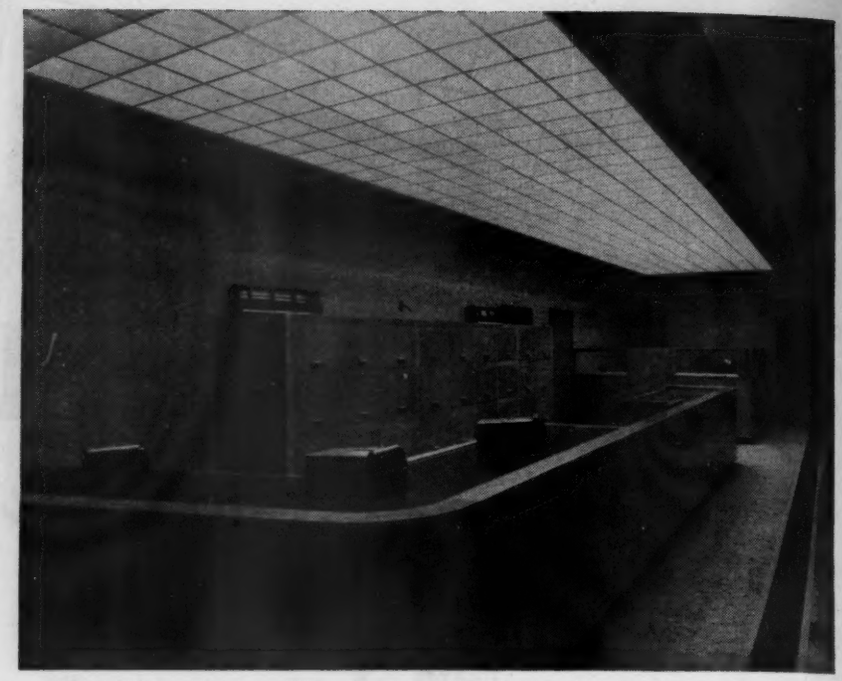


The cashier's desk and lamp sales counters are illuminated by fluorescent lamps mounted end-to-end and deeply louvred by wooden egg-crate construction. High reflection factors are selected for cabinets and desks as well as for wall and floor surfaces. Germicidal units are mounted on top of cabinets.

The appliance and lamp selling section is illuminated by pendent-mounted semi-indirect fixtures in recessed domes, and gyro spots recessed between coves and swivelled to highlight special displays.

seeing comfort. Studied color combinations produce a restful atmosphere while maintaining high reflection factors. Standard lighting equipment was used throughout the structure.

One feature of the new building is the display of modern kitchens that flank the lamp and appliance store. Lighting, both in-built and surface or pendent-mounted, as well as electric ranges, refrigerators and related appliances, are the products of all leading manufacturers so that prospective customers can view the merchandise they intend to purchase in an atmosphere or environment that can be re-created in the customer's own home. No two kitchens are alike. Each kitchen is designed for maximum economy of space and combines utility, convenience and beauty through the use of unusual color combinations, special lighting effects, photo murals, corner windows and novel snack bars.

The entirely air-conditioned building was designed by architects Edward M. Tanner representing J. C. Nichols, and Homer Neville of Neville, Sharp and Simon. Lighting engineering and designing was by J. M. Arthur, Jr., Manager of the Kansas City Power and Light Company's Lighting division.

In the News

Craft Unit Case Lost

Under the Taft-Hartley law many craft unions, mostly in the AFL, are trying to carve out small craft units where they may have members from the larger, plantwide bargaining group. The steel producing industry is particularly under attack. The NLRB has under consideration a test case brought by the bricklayers.

One of the first cases brought by the International Brotherhood of Electrical Workers, AFL, was lost to the Mine, Mill & Smelter Workers, CIO.

The cases involved two plants of Scovill Manufacturing Company, Waterbury, Conn., where the CIO has held bargaining rights since 1942 for all production and maintenance employees. Last year, however, the IBEW signed up members in two departments (1) electrical construction and maintenance and (2) steam, and sought an election from NLRB for these two departments, where it claimed to represent a majority.

The CIO intervened, since these two departments were part of the one big bargaining unit including all production and maintenance workers in both plants. The company sided with the CIO in contending that the past bargaining history on a broad two plant basis precluded the segregation of the two departments.

In denying the IBEW's petition, NLRB decided that "the functions and skills" of the employees involved does not establish them as a craft group, or that they have any special "community of interest". It cited testimony by a company official that employees in the electrical department range from top skill to common laborer. The same wide variation of skill was found in the steam department, which employs turbine engineers, boiler room engineers, machinists, pipe coverers, floormen and an ash gang.

NLRB found no justification for severing this group with "heterogeneous skills and functions" from the production and maintenance unit.

In general, NLRB holds that, for a craft unit, the workers comprise a distinct craft, that craft units be customary in the industry and that a majority of the workers involved favor the craft unit.

Investigating application of time control switches to rural and farmstead wiring are (L to R) Leroy E. Swanson, lighting engineer, Central Illinois Light Co., DeKalb, Ill.; R. Eyman, Paragon Electric Co., Two Rivers, Wis.; and contractors Wayne Cook, Virgil Cook Electric Co., DeKalb; G. R. Johnson, G. R. Johnson Co., Elburn, Ill.; and T. F. Halden, T. F. Halden Co., DeKalb.

Illinois Inspectors Convene in Chicago

At intervals electrical inspectors take a "holiday" from their code books to bring themselves abreast of the latest developments in the electrical industry. Ample opportunity to do this was afforded at the Eighteenth Annual Meeting of the Illinois Chapter, International Association of Electrical Inspectors held in Chicago's Hotel Sherman January 29th and 30th.

Following an opening plea of retiring chairman H. C. Frieden (Moline) for a renewal of effort to secure sales control ordinances for electrical devices, the agenda provided a full-scale review of recent industry advances. While discussing the subject of switch and fuse heating, F. S. Green, electrical engineer, Frank Adam Electric Co., St. Louis, asserted that such items should be tested under actual installation and operating conditions. Switch and fuse manufacturers are now cooperatively studying this problem, he added. Most trouble encountered in the field has been due to misuse of fuses, he revealed adding a word of caution against using "unlisted" fuses that have not passed Underwriter's tests. In answer to questions concerning the present "continuous load" carrying capacity of switches (about 70 percent of nameplate rating), Mr. Green revealed that tests now under way may lead to some measure of derating.

One of the latest advances in electric panel radiant heating for the home was described by E. W. Renfree, U. S. Rubber Company, Chicago. It is a four-foot square panel of conductive rubber that can be installed in the ceiling (at the wall line) of new homes. Rated at 17 watts per sq. ft. (22 watts for bathroom units), the units operate at 220 volts and can be connected to No. 12 conductor circuits. Panels are same thickness as conventional ceiling board (about $\frac{1}{4}$-inch); can be installed at time ceiling is installed; will never exceed a maximum of 120 degrees F.; will not affect wall paper, paint or other ceiling covering. A well insulated five or six room house can be heated by 11 to 12 kilowatts of panel units which cost about $2.00 per sq. ft. Total conductive rubber panel heating installation cost may run about 50 percent of a conventional heating system cost in a new home, Mr. Renfree revealed.

A Chicago Plan to certify residential buildings for wiring adequacy was announced by A. M. McGivern, speaking as a director of the Electric Association of Chicago. Certification will not be merely on a basis of number of outlets nor confined to single family

These are the BEST

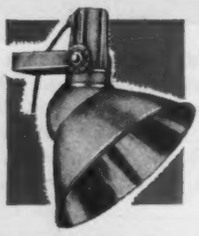
— without a doubt — the finest line of flood-lighting units ever to bear the famous SILV-A-KING label. And for a company which has enjoyed the reputation that has been SILV-A-KING'S for over a quarter-century — that's a lot.

ISLAND LIGHT

Life-time porcelain enamel Reflector. Cast aluminum support and top housing. Lamp mounted base up. All wiring encased.

SPORT AREA

Alzak aluminum floodlight. Calibrated for vertical and horizontal adjustments.

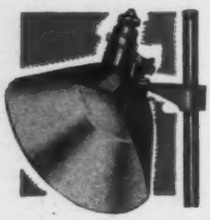


SUPER SERVICE

Life-time porcelain enamel floodlight. Calibrated for vertical and horizontal adjustments. Enclosed wiring bracket illustrated.

UNI-FLOOD

Life-time porcelain enamel floodlight. Swivel joints for complete adjustments. Open wiring bracket illustrated.



UTILITY

Floodlight of seamless, one-piece heavy-gauge aluminum. Swivel joints allow complete adjustment.

NEW CATALOG

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SILVAKING
LIGHTING EQUIPMENT

Listening to C. F. Kahn explain continuous row mounting features of newly engineered Kahn Mfg. Co., industrial fixture are: (L to R) M. D. Leedom, The M. O'Neil Co., Akron, Ohio store; D. L. Kingsbury and Peter Lukich of Kingsbury Electric Company, Cleveland.

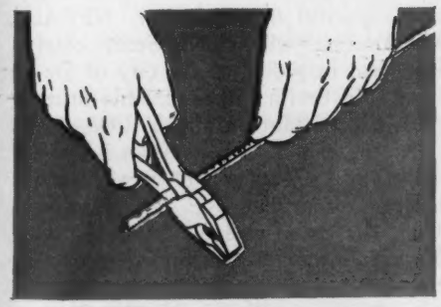
dwellings or houses. Since about 85 percent of Chicago's population live in apartments (most of them wired 25 to 30 years ago), the Association's "Wiring for Electrical Living" specifications are to be aimed at raising wiring standards in apartment houses. Main features of the specifications:

1. A combination range and distribution panel (switch or circuit breaker) located in the kitchen.
2. Minimum service to this panel —two No. 6 and one No. 8 conductors.
3. Two No. 12 appliance circuits in the kitchen (one outlet for every four feet of work space).
4. All other branch circuits throughout apartment to be No. 12 wire.
5. One outlet for every 12 lineal feet of wall space in all other rooms.
6. A light in every closet.

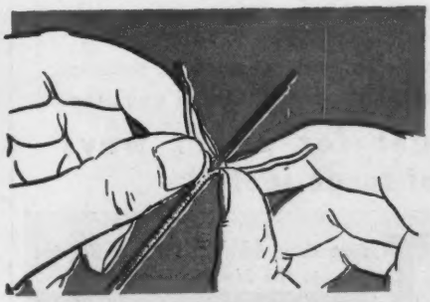
The specifications will deal only with wiring in the apartments. Feeders up to apartments are the problem of the consulting electrical engineer and contractor, Mr. McGivern asserted, and must be large enough to serve the new wiring standards.

A new electrical tape that will do the job of rubber and friction tape was demonstrated by S. P. VanArsdall, Jr., Minnesota Mining and Mfg. Co., Chicago. Known as "No. 33 Scotch Electrical Tape" the new insulation development combines a Vinyl backing (for dielectric strength) with a resin impregnation (for chemical resistance); is seven mils thick and has a dielectric strength of 1000-volts per mil; can be used in temperatures up to 200 degrees F. Scotch 33's advantages, according to Mr. VanArsdall are: Its resistance to water, salt, acids, alkalies, oils, alcohols and hydrocarbons; it reduces appreciably the area occupied by conventional taped joints in outlet and pull boxes.

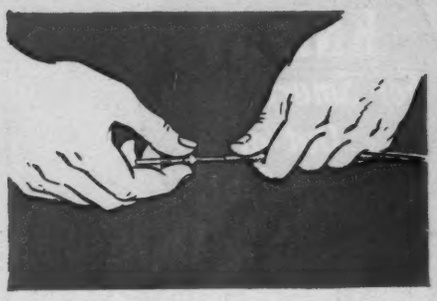
"It strips fast and easy ...It's Laytex RU"



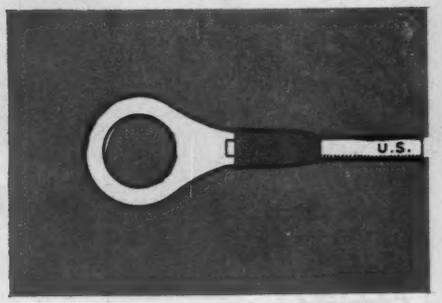
You don't need to use a knife when you strip Laytex RU. Just place the wire in the heel of side-cutter pliers—



and crush the cover for as far as you want to strip. This allows the saturated fibrous cotton cover—flame-retardant and moisture-resistant—to be quickly peeled back. The insulation is then easily rolled back . . . and you have a clean, quick strip.



There's no need to scrape with a knife—conductor is free of loose particles. Once you've made a connection, simply roll the insulation back over the barrel of the terminal and tape it up. You have a neat, streamlined job with *double* protection. In a laboratory test Laytex RU



was proved to be 33% to 300% easier to pull than 5 other leading brands. Most important of all, Laytex RU permits more wires per conduit on rewiring jobs because it is America's smallest diameter, lightest weight natural rubber insulated branch circuit wire. The dip process of applying the insulation guarantees perfect centering and no thin spots. Send today for sample plus booklet containing more details about this wire. Wire and Cable Department, United States Rubber Company, 1230 Avenue of the Americas, New York 20, N. Y.

Reg. U. S. Pat. Off.

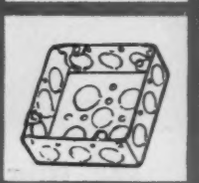
A PRODUCT OF

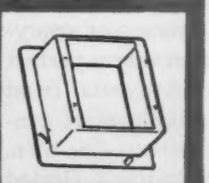
U.S. RUBBER
SERVING THROUGH SCIENCE

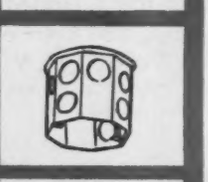
UNITED STATES RUBBER COMPANY

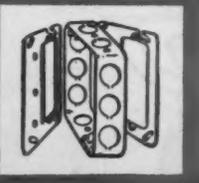
RU wiring with **RU?**

Turn to
KNIGHT
For Smart Ways
Out of
Tough Spots









KNIGHT
Licks a
Tough Spot in
Rockefeller Center
Eastern Airlines
Bldg.

KNIGHT Case History No. 1040

Lord Electric Company, famous electrical contractors, chose Knight Patented Concrete Outlet Boxes because other types of concrete boxes would change shape after the form was withdrawn, slowing down rapid progress on the Eastern Airlines Building of Rockefeller Center. Knight Patented Concrete Outlet Boxes turned the trick! Installations remained permanently secure — permitting big savings in time, labor and materials. These gains were a result of Knight reinforced construction consisting of two pieces lapped over and riveted together in the central portion of the outlet box—an exclusive Knight feature. Another problem was excessive pipe-bending due to the intricate conduit systems involved. Knight scored again with its patented Hung Ceiling Box. Completely adjustable, the Knight Hung Ceiling Box was installed quickly and conveniently — locked in position by a slight spreading of the mounting bars. Sizeable gains again resulted and the job was completed more quickly with less effort — at lower cost.

No wonder so many electrical contractors, such as the Lord Electric Company, and electrical engineers

turn to Knight for smart ways out of tough spots!

KNIGHT More than 40 YEARS of Service to the Electrical Trades
ELECTRICAL PRODUCTS CORP.
1357-63 Atlantic Ave., Brooklyn 16, N.Y.

Inspector Larry McNeill of Consolidated Edison Co., New York, compares inspection problems with Fred W. L. Hill, changeover engineer, Potomac Electric Power Co., Washington, during IAEI annual meeting in Atlantic City, N. J.

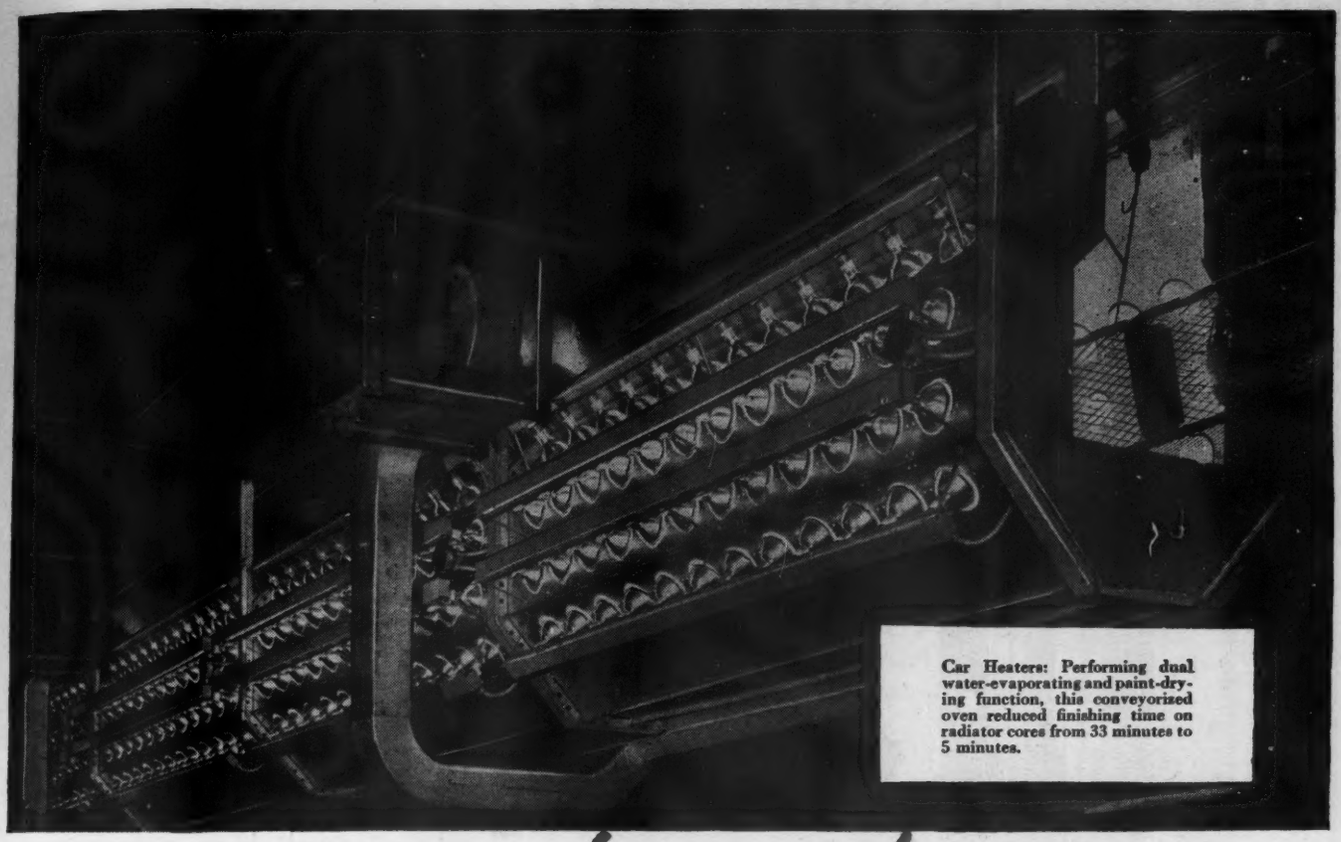
Other technical subject presentations included a review of the application and operation of automatic emergency transfer switches by Ray Ruddock, Automatic Switch Co., Chicago; Raymersion Infra-Red Ovens by P. H. Godell, Trumbull Electric Co., Chicago; and Requirements for Arc Welding Equipment by D. W. Just, assistant electrical engineer, Underwriters Laboratories. H. M. Dreher, NEMA, New York, presented a sound motion picture illustrating proper armored cable (BX) installation techniques. C. A. Wingfield, Commonwealth Edison Company, Chicago, discussed the human side of the equation in his talk on human relations.

The usual inspectors' problems session was ably led by Roy Burgess, assistant chief electrical inspector, City of Chicago.

Announcement was made of the approaching retirement of Victor H. Tousley (Sept. 1) as IAEI secretary and electrical field engineer, NFPA. His successor will be C. L. Smith, chief electrical inspector of the city of Detroit. Mr. Smith will assume his duties as Vic's assistant on May 1, 1948.

At the regular business session the following Chapter officers were elected: Chairman — F. K. Hanlin, Chicago; first vice-chairman—J. T. Swanson, Rockford; second vice-chairman—J. P. Moore, Chicago; third vice-chairman—D. W. McGill, Danville. W. J. Alcock, Chicago, was re-elected secretary-treasurer.

Members of the executive committee are: Chairman—C. A. Wingfield, Chicago; Contractors — George W. Reinke, Chicago; Wholesalers—Roy F. Diehl, Rockford; Manufacturers—Theodore W. Briegel, Galva, Illinois.



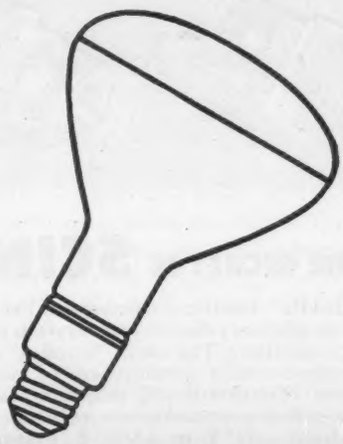
Car Heaters: Performing dual water-evaporating and paint-drying function, this conveyorized oven reduced finishing time on radiator cores from 33 minutes to 5 minutes.

WESTINGHOUSE *Infrared Lamps*
CUT FINISHING TIME 85%

Experience in a wide variety of applications has proved to users that Westinghouse Infrared Lamps do the job faster, easier, cheaper. Here's why:

- Highly efficient source of heat
- Saves man power
- Saves space
- No standby loss
- Flexible
- Safe and comfortable
- Small initial investment
- Low maintenance cost

Check into your present baking, drying and heating methods—then get the facts on radiant heat processing with Westinghouse Industrial Infrared Lamps.



Send for free booklet (Form A-3817) giving check list of applications, types of lamps and helpful application data. Lamp Division, Westinghouse Electric Corp., Bloomfield, N. J.

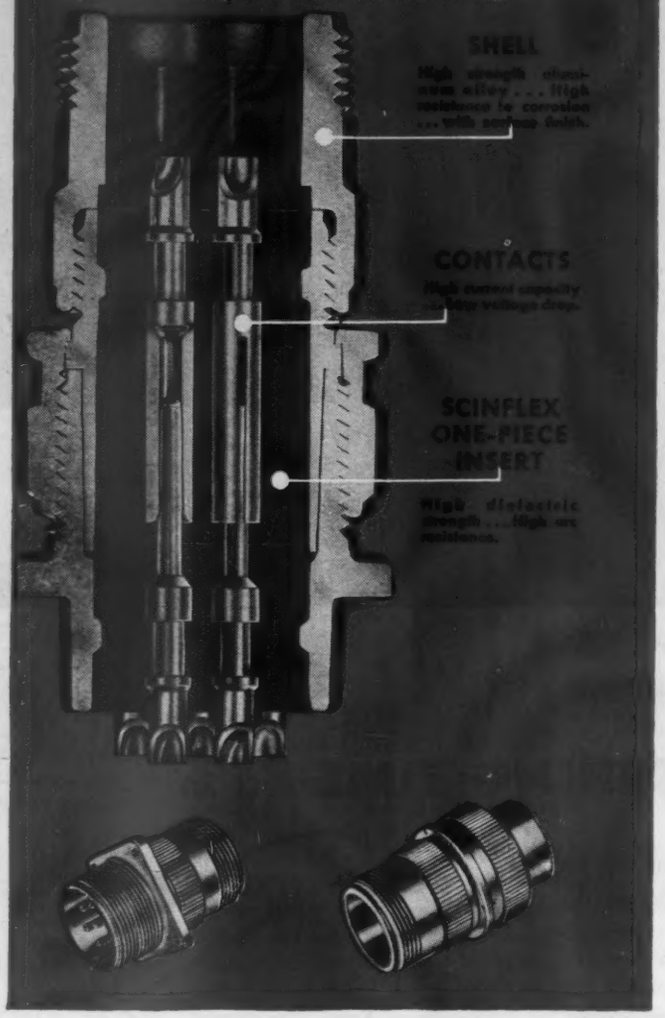
Westinghouse *Lamps*

PLANTS IN 25 CITIES • OFFICES EVERYWHERE

Westinghouse Lamp District Offices:
10 High St., BOSTON; 2480 Peachtree Rd., CHAMBLEE, GA.; 20 N. Wacker Drive, CHICAGO; 40 Wall St., NEW YORK; 3001 Walnut St., PHILADELPHIA; 30 Blvd. of Allies, PITTSBURGH; 410 Bush St., SAN FRANCISCO; 411 N. 7th St., ST. LOUIS

BENDIX-SCINTILLA

the finest ELECTRICAL CONNECTORS money can build or buy!



AND THE SECRET IS SCINFLEX!

Bendix-Scintilla* Electrical Connectors are precision-built to render peak efficiency day-in and day-out even under difficult operating conditions. The use of "Scinflex" dielectric material, a new Bendix-Scintilla development of outstanding stability, makes them vibration-proof, moisture-proof, pressure-tight, and increases flashover and creepage distances. In temperature extremes, from —67° F. to +300° F., performance is remarkable. Dielectric strength is never less than 300 volts per mil.

The contacts, made of the finest materials, carry maximum currents with the lowest voltage drop known to the industry. Bendix-Scintilla Connectors have fewer parts than any other connector on the market—an exclusive feature that means lower maintenance cost and better performance.

*REG. U.S. PAT. OFF.

Write our Sales Department for detailed information.

• Moisture-proof, Pressure-tight • Radio Quiet • Single-piece Inserts • Vibration-proof • Light Weight • High Arc Resistance • Easy Assembly and Disassembly • Less parts than any other Connector

Available in all Standard A.N. Contact Configurations

BENDIX SCINTILLA — SCINTILLA MAGNETO DIVISION OF SIDNEY, N. Y. — AVIATION CORPORATION

Two electrical engineers who play an important role in the contracting activities of the Shelley Electric Co., Wichita, Kansas, are Clyde Whitchurch (left) who handles estimating and P. W. Agrelius, vice-president of the firm.

Illinois Electrical Contractors Meet

Lyle Foster, retiring president of the Illinois Chapter of the National Electrical Contractors Association, will head a committee to plan for a convention to be held by the state group in Peoria in October, 1948.

E. B. Oberlander of Peoria, who was installed president and chairman of the executive committee of the state chapter at its dinner meeting in December, appointed Mr. Foster chairman of the committee.

Other officers of the state chapter, who were elected in August and installed at the dinner besides Mr. Oberlander were Glenn Durham, Springfield, vice president; Ray Best, Peoria, treasurer; and John Jacob, executive committeeman.

Farm Electrification To Be Studied

The U. S. Department of Agriculture announced recently approval of four more projects under the Research and Marketing Act covering: (1) A study of the effect of production risks on farm costs and income and ways of reducing the cost of these risks; (2) A study of what factors effect the use of electricity on farms and how greater use of electricity can increase earning ability, (3) the economic effects of transportation costs on agriculture; and (4) how can transportation of farm products be improved. The first three studies will be conducted by the Bureau of Agricultural Economics in cooperation with appropriate govern-

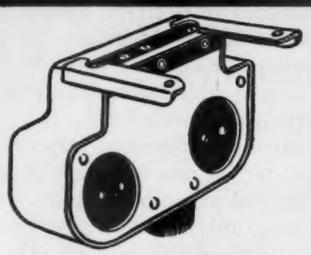
MITCHELL

"TWIN TURRET" HEAVY-DUTY INDUSTRIAL LIGHTING UNIT

Positively Eliminates Broken Sockets . . . Lamps Can't Fall, Regardless of Vibration

Fixtures with porcelain enamel reflectors bear the R.L.M. label.

MITCHELL R L M



The Remarkable New "Twin Turret" Lampholder

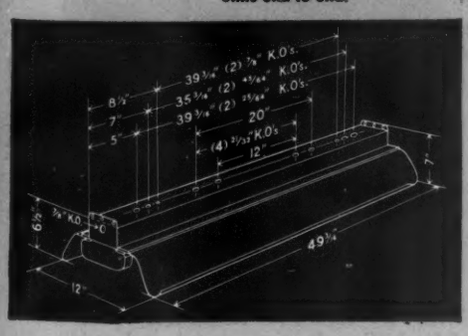
Rigid, sturdy and *unbreakable*. Powerful spring tension on both ends, and positive spring action holds lamps so they *cannot fall out*. Completely eliminates annoying flickering caused by poor electrical contact.

MODEL NO. 2100. 2-40 WATT, BAKED ENAMEL
MODEL NO. 2101. INSTANT-START, 2-40 WATT, BAKED ENAMEL
MODEL NO. 2102. R.L.M. STANDARD, 2-40 WATT, PORCELAIN
MODEL NO. 2103. R.L.M. STANDARD, INSTANT-START, 2-40 WATT, PORCELAIN

Chain Suspension
Use Part No. 302 (8-ft. Tenso chains with "S" hooks) to hang units from ceiling. Chains hook on brackets at each end of unit.

Rigid Mounting
Knockouts on top of steel wireway channel permit stem or rod mounting, individually or in groups or rows.

Continuous Row
Knockouts at either end of channel permit mounting and wiring units end to end.



All-Steel Fluorescent Industrial Unit with New "Twin Turret" Lampholders

Industrial users enthusiastically acclaim this latest MITCHELL IMPROVED Fluorescent unit equipped with the remarkable new "Twin Turret" lampholders. Puts an end, once and for all, to broken sockets! Holds lamps tightly and firmly —*they can't fall out!* No need for "safety gadgets"—no more broken lamps—no more wasteful servicing. Lamps slip easily into the "Twin Turret" holders, and *they stay aligned perfectly in the fixture.* Results in a better, more dependable Industrial lighting unit.

The MITCHELL "Twin Turret" unit features strong steel construction throughout. Brackets are provided at each end for chain suspension. Knockouts are included for conduit or rod mounting, and for end-to-end continuous row installation. Baked enamel units are finished in rich, durable grey. Porcelain units are finished in Royal Blue-Black exterior. Unit uses "brick type" U.L. and E.T.L.-Approved ballast. Completely wired, ready for convenient hanging. Bears Underwriters' label. Uses two T-12 40-watt fluorescent lamps. Operates on 110-125 volts, 60 cycles A.C. Dimensions: 49⅜" long, 12" wide, 7" deep. Packed individually. (Also available for other voltages and frequencies on special order.)

Model No.	Description	Shpg Wt.
2100	2-40 Watt Baked Enamel	27 lbs.
2101	Instant-Start, 2-40 Watt, Baked Enamel	30 lbs.
2102	R.L.M. Standard, 2-40 Watt, Porcelain	30 lbs.
2103	R.L.M. Standard, Instant-Start, 2-40 Watt, Porcelain	33 lbs.

Mitchell Manufacturing Company
2525 CLYBOURN AVENUE, CHICAGO 14, ILLINOIS
In Canada: Mitchell Manufacturing Company, Ltd., Toronto, Canada
Far West: *Complete Modern Plant and Sales Office at Los Angeles Serves the Entire Pacific Coast Area*
1019 NORTH MADISON AVENUE, LOS ANGELES 27, CALIFORNIA

MITCHELL
First Choice in Lighting

It's going to cost $2.00 for this electrician to go to the machine he is to wire up. It is not a big job, but if it isn't done with tape that will last in spite of oil, water and acids, he'll be doing it again in a year or so. Why not fix it so there won't be any "next trip" to do the job over and cost another $2.00. Give your electrician No. 33 "SCOTCH" Electrical Tape with Vinyl Plastic Backing and he'll do any wiring job more quickly, because he'll be using only one tape instead of two tapes—rubber and friction. He'll do a neater job because No. 33 "SCOTCH" Electrical Tape doesn't bulk; only six one thousandths of an inch thick. He'll be doing a permanent job because No. 33 "SCOTCH" Electrical Tape with Vinyl Plastic Backing is unharmed by sunlight; water, fresh or salt; acids; alkalis; alcohols or oil. Ask for a free sample of No. 33 "SCOTCH" Tape and give it a trial.

REG. U.S. PAT. OFF.

No. 33 SCOTCH BRAND Electrical TAPE

WITH VINYL PLASTIC BACKING

ANOTHER 3M COMPANY PRODUCT

Made in U. S. A. by MINNESOTA MINING & MFG. CO. SAINT PAUL 6, MINNESOTA

ment or non-government agencies, and the fourth by the Marketing Facilities Branch of the Production and Marketing Administration.

The study of farm electrification will cover the effect of such factors as the type, size, and principal enterprises of the farm, location, electric rates, and local customs and practices upon the amount and profitable use of electricity on farms. The main objective is to obtain data that will help farmers to increase their efficiency and net returns from crop and livestock production through greater use of electric power. Such information should also be useful to organizations interested in farm electrification.

St. Louis County Gets Electrical Code

St. Louis County in Missouri recently adopted an electrical code which follows closely the standards of the 1947 National Electrical Code. It will be effective in all unincorporated areas within the county lines.

Appointed as electrical supervisor to administer the new code was Walter A. Mason who plans to resign his position as superintendent of county buildings to take over the new job. He or his assistants will inspect all work on a fee basis determined by a schedule set up in the code. Mason formerly was recording secretary of Local No. 1, I.B.E.W.

Effective with the new code is a licensing regulation whereby all elec-

Eastern New England Chapter, IAEI, Eastern Section members attending annual meeting in Atlantic City were (l. to r.) John J. Hennessey, wire inspector, Brookline, Mass., Bernard B. Whelan, supt. Wire Division, Boston, Otto H. Zamore, inspector, Boston Edison Co., Boston, and Leo Landry, supt. of wires, Watertown, Mass.

information
ON WIRES, CORDS AND CABLES
for every use!

NOW—to make the selection of wires, cables, and cords easy—get your free copy of the new, complete catalog of General Electric *Building Wires, Cables, and Cords.* In one easy-to-use book, this new catalog lets you make your choice from the *complete* line. It includes wires, cables, and cords for every use—for industrial, manufacturing, and building applications.

Partial list of contents covers:

Thermoplastic Building Wires

Rubber-insulated and Leaded Building Wires and Cables

BX* Armored Cable

PVX Nonmetallic Sheathed Cable

Service Entrance Cable

Flamenol* Cords

Rubber Jacket Cords

Fixture Wires and Cords

Latest National Electrical Code Requirements

**Trade-mark Reg. U. S. Pat. Off.*

To get your copy early, just fill out the coupon and mail it today.

Section WI-318
General Electric Company
Bridgeport 2, Connecticut

Please send me the new, free catalog *Building Wires, Cables and Cords for every purpose.*

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Address_____

City_____ Zone_____ State_____

Wires and Cables
GENERAL ELECTRIC

Will your next fluorescent installation be years ahead– *or behind?*

HOLDENLINE ARROWHEAD FIXTURE. Catalog No. CP-240. Ballast enclosed in channel. Patents pending.

Commercial louver design has changed!

Customers have never liked eye-tiring brightness contrasts on the surface of fluorescent louvers. Today, however, you have a new PL/PL tool that *completely solves this problem.*

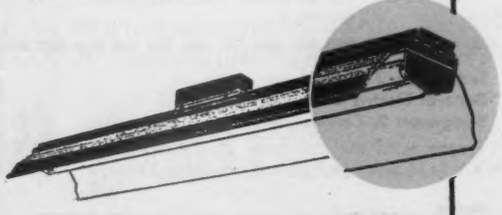
The Holdenline Arrowhead commercial louver features *controlled surface brightness.* All plastic, it has no metal restraining parts. The result: *uniformly low surface brightness ranging from 1.1 cp. to 2.6 cp. per square inch.* There are absolutely no dark-to-bright contrasts. This advanced louver is equally attractive whether operating or unlighted.

For surface or pendant, individual or continuous mounting, the Holdenline Arrowhead fixture diffuses light evenly. *Ceiling and wall "hot spots" are eliminated.* Thus, you can now easily achieve remarkably low brightness ratios.

There are important maintenance features too. No bug graveyard, the Arrowhead louver is shaped to prevent dirt accumulation. It snaps into place on the channel without screws. Self-locking sides, longitudinal and transverse louver sections are all made of the same identical material, bonded into a sturdy, integral, all-plastic unit. An Arrowhead louver can't warp, sag, expand or discolor under any normal operating conditions. *This fixture is backed by the traditional Holdenline guarantee.*

All the versatile features of Holdenline INDUSTRIAL Chan'l-Run are built into the Arrowhead commercial fixture —for faster wiring . . . easier hanging . . . longer socket life.

Satisfy customer needs today with years-ahead Arrowhead louver design and assure future repeat business. On your next commercial job recommend the Holdenline Arrowhead fluorescent fixture—*with the only all-plastic, controlled brightness louver.* Prompt delivery, through electrical wholesalers exclusively.



INDUSTRIAL AND COMMERCIAL CHAN'L-RUN BASIC UNIT SYSTEM

- Individual or continuous runs with standardized heavy-gauge units.
- Sockets mounted on welded end plate for positive lamp spacing.
- End plate protects sockets during shipment and maintenance.
- Faster, easier hanging and wire pulling without close-fitting nipples.

HOLDENLINE CO.

Pioneers In Fluorescent

2291 Scranton Road • Cleveland 13, Ohio

HOLDENLINE—T. M. REG. U. S. PAT. OFF. 1937 U. L. APPROVED A. F. L. MADE AND WIRED

tricians operating in the areas affected will be licensed by a Board of Examiners composed of electrical contractor Frank Hoag of Overland, electrician James Quinn of Pine Lawn, and Associate Judge Arthur W. Schmid of the County Court. All are members of an advisory commission to draw up a county building code.

License fees for electrical contractors are $75 annually; for maintenance contractors, $35 per year.

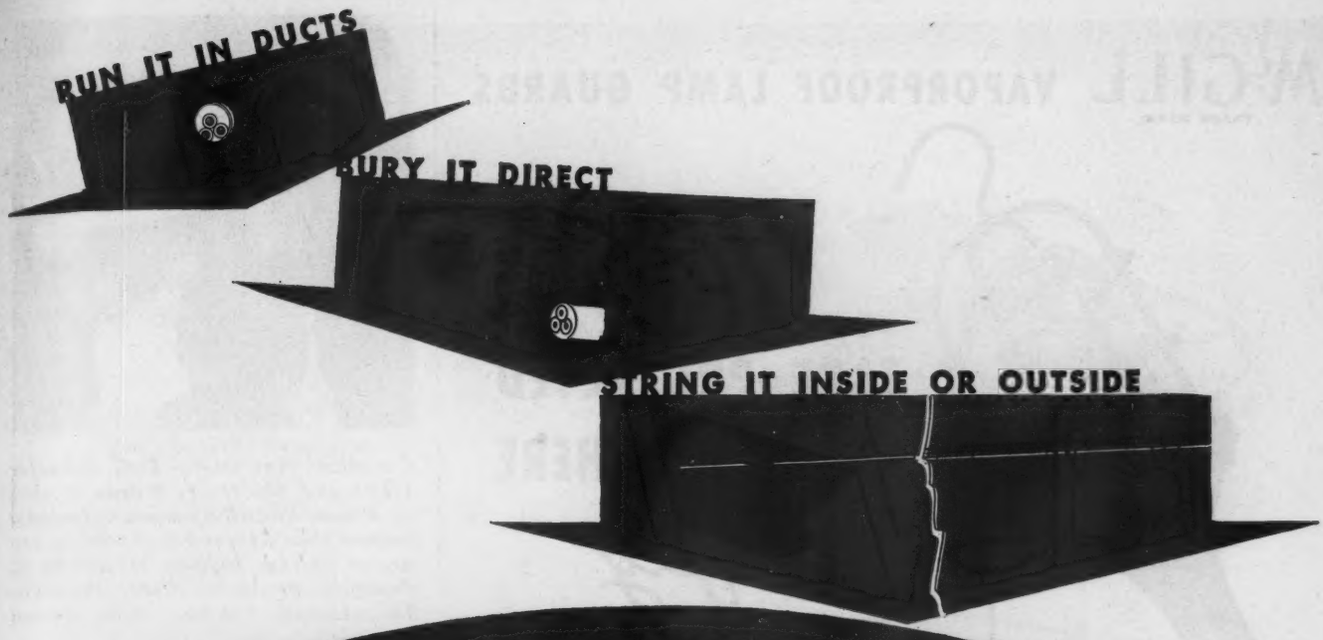
Casler Heads Indianapolis Group

Les Casler was elected chairman and James Crump, vice-chairman of the Contractors Division of the Electric League of Indianapolis at a recent meeting of that group. Members of the Advisory Committee are: Walter Meyers, Charles Coonce and H. W. Claffey.

Washington State Contractors Elect

The Electrical Contractors Society of Washington State has elected Homer V. Noland of Walla Walla as president. J. M. Hooper, Seattle, is 1st vice president; Everett Hindman, Bellingham, 2nd vice president; T. R. Neilson, Seattle, secretary-treasurer, and Bernie Cohen, Seattle, trustee. Members of the executive board are R. R. Ecker, Pasco; Art Seigel, Seattle; Don Willingham, Everett; Keith Odell, Yakima, and A. G. Neill, Snohomish.

Gathering technical material at the International Lighting Exposition are (L to R) H E. Sahlin, and A. Wiglama, engineer and supt. of engineering construction respectively for The Borden Company, Chicago; also J. G. Wayne, estimator and supervisor of the George H. Bach Electric Co., Chicago electrical contractors.



Special cable to meet special service requirements — that's usually a pretty safe rule to follow. But every good rule has an exception sometimes and, such an exception is Hazasheath.

Tinned copper conductors are first protected with a strong, resilient wall of moisture-resistant Submarine insulation. Over this conductor insulation goes tightly wound protective tapes. And then to give this cable its installation versatility, the outer sheath is a thick jacket of Hazaprene, compounded with neoprene, and mold cured under heavy pressure. This Hazasheath jacket resists oil, sunlight, acids, moisture, chemicals and mechanical damage. It has all the necessary protection for aerial, underground or conduit service built in . . . makes cable installation simple, fast and economical. For complete details, see your Hazard representative or write for Hazasheath Bulletin 322. Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pa.

5165

HAZARD

insulated wires and cables for every electrical use

McGILL VAPORPROOF LAMP GUARDS

TRADE MARK

No 3005*

TAKE PROTECTED LIGHT ANYWHERE *Safely*

Be sure of complete safety from fire and other disaster caused by a spark, heat or breakage of light bulbs with a McGILL Vaporproof Portable Guard.

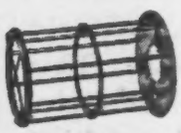
Models designed for particular uses include such important features as brass or fibre cages, unbreakable moulded bakelite handles, heat and impact resistant globes. Completely air tight and waterproof.

Over a hundred other McGILL Lamp and Wall Guards available. Each built for a specific requirement of industry. They insure safe, convenient light anywhere it is needed — thereby increasing production efficiency.

*No. 3005 Vaporproof Guard has a heavy brass wire cage with sealed Insurok handle and air and moisture proof globe that is heat and impact resistant. Lamp size — 100 W.

No. 8000-SR equipped with No-Rol cage of zinc plated wire. Polished wood handle with LEVOLIER* Switch. Lamp size — 40-100 W. (*T.M. Reg U.S. Pat. Off.)

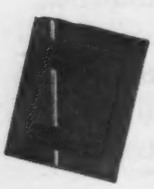
No. 4675 uses polished wood handle with LEVOLIER* Switch. Cage of zinc plated heavy steel wire Lamp size — 25-100 W (*T.M. Reg U.S. Pat. Off.)



No. 1440 Wall Guard for protection of bulbs exposed to theft and damage. Lamp size — 100 W

McGILL Adaptable Lamp Changers stop lamp changing hazards Safety insulated Convenient to use

Send today for McGILL Catalog No. 43 so that you can pick out the lamp guard that will most effectively solve your own problems.



McGILL MANUFACTURING CO., INC.

Electrical Division

450 N. Campbell St., Valparaiso, Indiana

Canadian contractors Jack Schaefer (left) and Charles J. Wilson (right) of Wilson Electric Company, Toronto, inspect glass fluorescent fixture enclosure at Chicago lighting show. N. E. Passman, president, Planet Products, Inc., Chicago, outlines light control features.

NISA Chapter Officers

J. E. Jenkins, Armature Winding Company, Charlotte, N. C., is the 1948 president of the Southeastern Chapter, NISA. Also elected at the annual meeting held at Richmond, Va., were: vice-president — Howard A. Lilly, Tampa Armature Works, Tampa, Fla.; secretary-treasurer—W. H. Grey, Southern Electric Service, Greenville, South Carolina.

Tennessee Chapter officers elected at a recent meeting include: president—M. G. Miller, Tennessee Elctric Motor Service, Knoxville; vice-president—Earl E. Wright, Dixie Industrial Service, Chattanooga; secretary-treasurer—Joe Wescott. Chosen as directors were: Ralph W. Trobaugh, Industrial Electric & Supply Co., Memphis; and J. V. Edenfield, Nashville Armature Company, Nashville.

Construction Projects by Navy

During 1948 some 150 armory projects to cost about $11,000,000 will be built by the Navy's Bureau of Yards and Docks as part of the large program being carried out to train a total naval reserve of 750,000 officers and men.

Of the 429 construction projects planned in 300 cities at a total cost of nearly $36,000,000, about 60 percent of the program or 279 projects costing over $24,000,000 were in various stages of completion late in 1947. Of these jobs, 202 were being done

CONSTANT VOLTAGE

puts the "safety" in safety controls

Without CONSTANT VOLTAGE protection, this self-sustaining link in the chain of relay points that chart the nation's airways, could not successfully perform its safety function.

It is remotely located, at times almost inaccessible to service personnel and solely dependent on local power service. Were it not for a SOLA Constant Voltage Transformer, its delicately engineered electronic and radio equipment would be constantly at the mercy of periodic and unpredictable surges or low voltage levels.

Throughout the entire cross-country system SOLA Constant Voltage Transformers maintain operating voltages at a constant, predetermined level and the nation's air-men fly their courses with confidence.

If you are building electrically energized equipment to operate at precise voltage levels, remember this: *it is more economical to include Constant Voltage protection in your design than to install it later as a remedial measure.*

Revised Bulletin JCV-102 available on request. Write for your copy.

31 standard types of SOLA Constant Voltage Transformers available in capacities ranging from 10VA to 15 KVA.

SOLA *Constant Voltage* **TRANSFORMERS**

Transformers for: Constant Voltage • Cold Cathode Lighting • Airport Lighting • Series Lighting • Fluorescent Lighting • Luminous Tube Signs Oil Burner Ignition • X-Ray • Power • Controls • Signal Systems • etc. • **SOLA ELECTRIC COMPANY, 4633 W. 16th Street, Chicago 50, Illinois**

Manufactured under license by: ENDURANCE ELECTRIC CO., Concord West, N. S. W., Australia · ADVANCE COMPONENTS LTD., Walthamstow, E., England · UCOA RADIO S.A., Buenos Aires, Argentina · M. C. B. & VERITABLE ALTER, Courbevoie (Seine), France

AIR EQUIPMENT TO HELP YOUR BUSINESS

A FAVORITE

. . . With Users
. . . With Contractors
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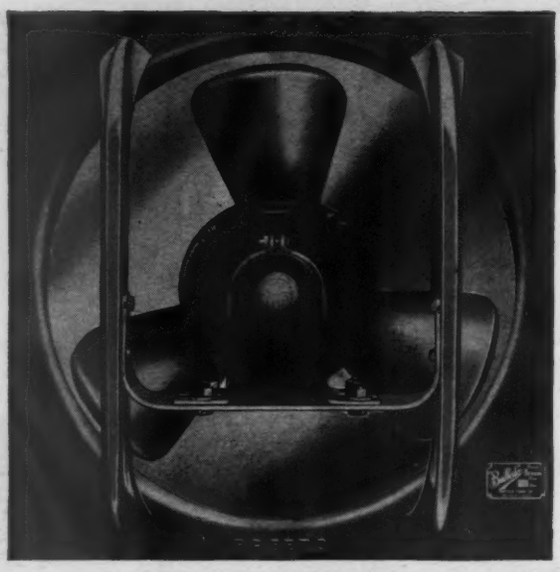

BUFFALO BREEZO FAN

- Delivers more air at less cost — quietly! Durable on the job.
- Easy to install! Square opening may be used. Can be bolted directly to face of wall.
- Easy to service — requires only occasional lubrication. Simple, accessible construction.
- Husky throughout! Sturdy die-stamped square panel. Rigid bracket and panel arms.
- Six sizes up to 24" to suit the need. Also available in pulley models, without motor.

OTHER PROVEN BUFFALO FANS DESCRIBED IN BULLETIN 3222-D.

Write for your copy!

BUFFALO FORGE COMPANY

520 BROADWAY BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

FANS BY Buffalo

EQUIPMENT FOR

★ VENTILATING ★ FORCED DRAFT
★ HEATING ★ INDUCED DRAFT
★ COMFORT COOLING ★ AIR WASHING ★ PRESSURE BLOWING
★ PROCESS COOLING ★ EXHAUSTING ★ CLEANING
★ AIR TEMPERING ★ BLOWING ★ DRYING

CUTTING COSTS IN EVERY BRANCH OF INDUSTRY

by competitive contracts and 77 by Navy forces. The work already underway includes 140 new armories built of the Navy's quonset hut developed during the war.

Vancouver Inspectors Elect Officers

L. H. Miller, electrical inspector for the city of Vancouver, B. C., has been elected president of the Electrical Inspector's Association of B. C., succeeding H. L. Taylor, provincial electrical inspector.

Other officers are vice president, L. Robson, provincial electrical department; honorary treasurer, J. Walker, provincial electrical department; honorary secretary, R. Hall, Electrical Service League.

Book Reviews...

Industrial Infrared

For the first time in a single book, an attempt has been successfully made to compile all essential data necessary for a clear understanding of the place infrared radiation occupies in the field of heat transfer with the reasons for its rapid growth and acceptance as an industrial heating tool. Titled "Industrial Application of Infrared," the book contains much technical and non-technical data and information designed to acquaint the industrial heat user with the availability, characteristics and performance of the infrared lamp and related equipment. The book is written by James D. Hall, advisory engineer in charge of the large filament lamp section in the commercial engineering department of the Westinghouse Lamp Division. Mr. Hall has been connected with the designing and development of infrared lamps since their introduction.

Included in the book are operating characteristics, description of available equipment, outlines for test procedures, data on installation design and many special industrial application examples. Some of the unusual, large and interesting jobs already installed are presented with text, diagrams, tables and photographs. Also covered are domestic and miscellaneous uses for infrared radiation, effects of infrared on the human body, infrared glass filters and gas-fired infrared generators.

Published by the McGraw-Hill Book Company, New York, it is priced at $3.50 and contains 201 pages, 6-by-9 inches in size.

The same

HIGH QUALITY... in EVERY SIZE!

What a difference in size a few hundred Amperes make!... and Federal makes them all—from the 2 lb. Pony Switch through the giant Safety Switch that handles 1200 Amperes without being bothered.

Representative Federal NOARK Safety Switches. The smallest is #71, 30 amps., 125 volts, weight 2 lbs.; the largest is #211246, fusible type-A (heavy duty), 1200 amps., weight 750 lbs.

For every application where quality counts . . . it's

Federal NOARK Safety Switches

One thing is certain: regardless of size, weight, or rating, the Federal NOARK signature on a safety switch stands for forward-looking engineering, thoroughgoing honesty of manufacture, and reliability you can bank on.

Write for a copy of the "Federalog"

Executive Offices: 50 Paris Street, Newark 5, N. J.
Plants: Hartford, Conn. • Newark, N. J. • St. Louis, Mo.
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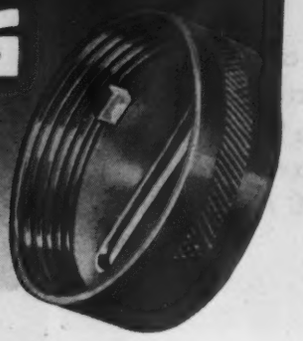
Federal Electric Products Company, Manufacturers of a Complete Line of Electrical Products, including Motor Controls • Safety Switches • Service Equipment • Circuit Breakers • Panelboards • Switchboards • Bus Duct

New POSITIVE LOCK Construction of Monarch Renewable Fuses

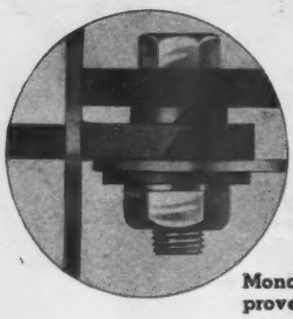
Assures → TRUE ALIGNMENT



The brass lugs inside the caps used on Monarch Fuses (see illustration at right above) fit into equally spaced slots in the brass casing inserts. This new and improved Monarch construction assures true alignment of the copper holding terminals . . . and establishes a positive lock on both ends of the fuse.

and for

STILL GREATER PROTECTION . . .



MONARCH'S Compressed Tension Lock Washer construction (illustrated at left) compensates for contraction and expansion of the fibre bar by exerting constant tension on the bar . . . and assures no loose parts. The washer also separates the fibre bar from the copper terminals . . . a spacer to provide better cooling.

Monarch Fuses are fully approved and are available through recognized wholesalers.

Specify Monarch Fuses for improved FUSErvice

MONARCH FUSE CO., LTD.
118 E. FIRST ST., JAMESTOWN, N. Y.

Dates Ahead

National Electrical Manufacturers Association—Winter Convention, Edgewater Beach Hotel, Chicago, Ill., March 14-18.

Illuminating Engineering Society—Canadian Regional Conference, Chateau Laurier, Ottawa, Ont., March 15-16.

American Society of Tool Engineers—Sixteenth Annual Meeting, Cleveland, Ohio, March 15-19. Hotel Cleveland.

American Society of Tool Engineers' Sixth Industrial Exposition — Public Auditorium, Cleveland, Ohio, March 15-19.

Chicago Production Conference and Show —sponsored by Chicago Technical Societies Council, Stevens Hotel, Chicago, Mar. 22-24.

National Electrical Contractors Association—District 5, Annual Meeting and Electrical Exposition, Baker Hotel, Dallas, March 29-31.

National Association of Corrosion Engineers—Fourth annual Conference and Exhibition, Jefferson Hotel, St. Louis, Mo., April 5-8.

Edison Electric Institute—14th Annual Sales Conference, Edgewater Beach Hotel, Cchicago, Ill., April 6-8.

Electrical Manufacturers Representative Association, Inc. — Annual Electrical Show, Alcazar, Baltimore, Md., April 6-8.

Midwest Power Conference — Tenth annual conference, sponsored by Illinois Institute of Technology, Sheraton Hotel, Chicago, Ill., April 7-9.

San Francisco Real Estate Board and Associated Home Builders of San Francisco, Inc.—Home Show, Civic Auditorium, San Francisco, Calif., April 7-14.

Home Builders Council of New York, New Jersey and Connecticut—Annual Home Show, Grand Central Palace, New York, N. Y., April 17-24.

Illuminating Engineering Society—Southwestern Regional Conference, Hotel White-Plaza, Dallas, Texas, April 18-20.

National Industrial Service Association—Annual convention, Hotel William Penn., Pittsburgh, Pa., April 26-29.

Chamber of Commerce—Annual meeting, Washington, D. C., April 27-29.

National Electrical Wholesalers Association—Annual convention, Statler Hotel, Buffalo, N. Y., May 2-7.

Edison Electric Institute—Annual Engineering meetings, Edgewater Beach Hotel, Chicago, Ill., May 3-5.

Westinghouse Agent Distributors Association—Hotel Statler, Buffalo, N. Y., May 9-11.

National Fire Protection Assn.—Annual meeting, Statler Hotel, Washington, D. C., May 10-13.

Electrical Manufacturer's Representatives Assn. of Michigan—Industrial Electrical Exhibit, Convention Hall, Detroit, Mich., May 12-14.

Illuminating Engineering Society —East Central Regional Conference, Mellen Institute, Pittsburgh, Pa., May 13-14.

Society of the Plastics Industry—Annual Meeting, Ambassador Hotel, Atlantic City, N. J., May 20-21.

Illuminating Engineering Society — Midwestern Regional Conference, Hotel Nicollet, Minneapolis, Minn., May 27-28.

Edison Electric Institute—Annual convention, Atlantic City, N. J., June 2-4.

Illuminating Engineering Society—Great Lakes Regional Conference, Hotel Statler, Detroit, Mich., June 16-18.

Cold Cathode Fluorescent Lighting Exhibit—Grand Central Palace, New York City, July 6-10.

American Institute of Electrical Engineers —Summer General Meeting, Palace of Fine Arts, Mexicon City, Mexico, June 21-25.

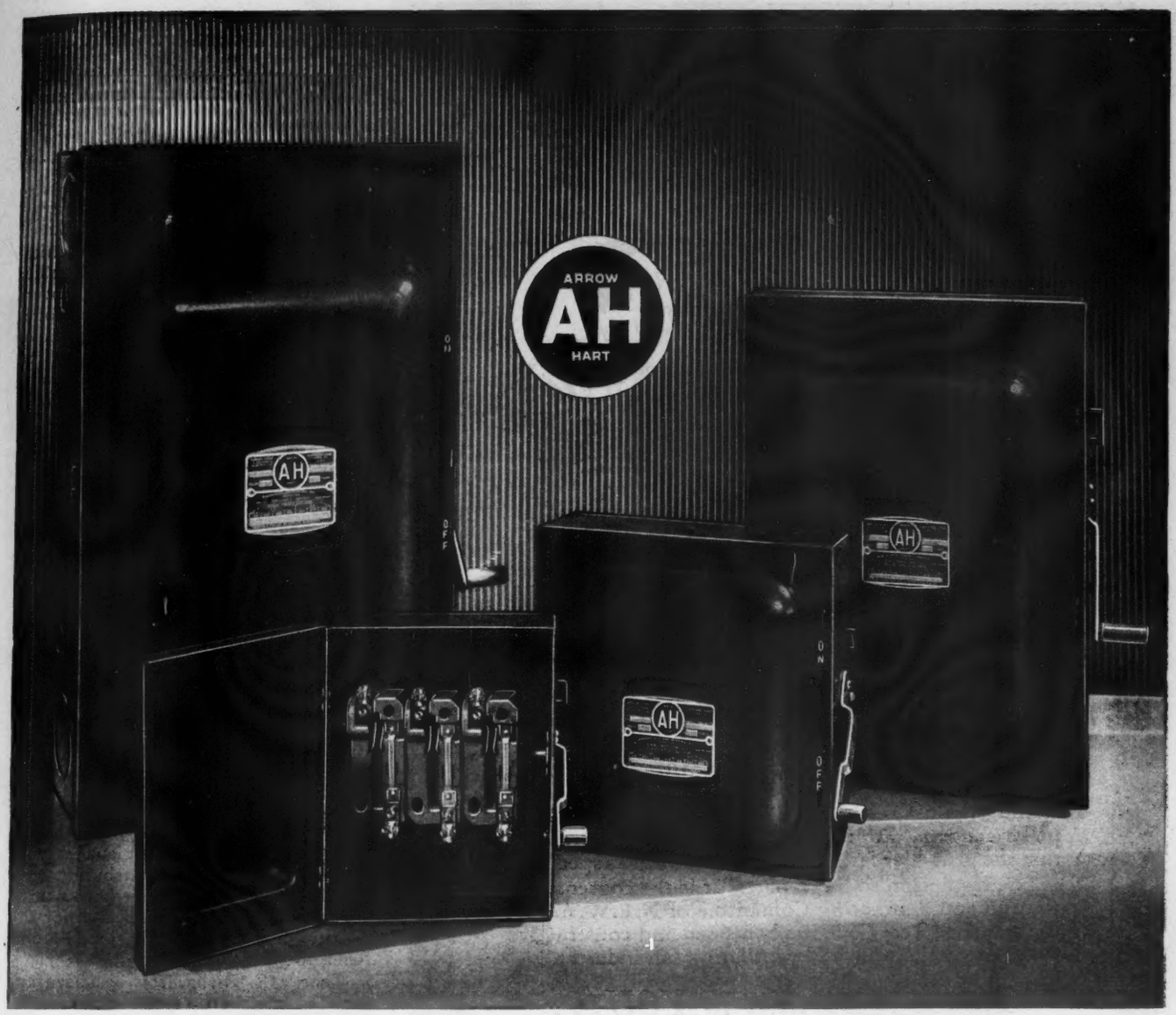
Second International Store Modernization Show—Grand Central Palace, New York, N. Y., July 6-10.

International Association of Electrical Inspectors — Western Section, Denver, Colo., September 13-15; Northwestern Section, Salt Lake City, Utah, September 20-22; Southwestern Section, Oakland, Calif., September 27-29; Eastern Section, October 11-13; Southern Section, Heidelberg Hotel, Jackson, Miss., October 18-20.

Illuminating Engineering Society — National Technical Confermence, Boston, Mass., September 20-24.

National Electrical Manufacturers Association—Traymore Hotel, Atlantic City, N. J., November 8-13.

National Electrical Contractors Association—47th Annual Meeting, Roney Plaza Hotel, Miami, Fla., November 30-December 3.



Enclosed Switches TYPES "A" and "C"

These safety controls of the higher grades serve for a wide range of applications, — reliably in all. Each type embodies the finest materials and workmanship its price-class affords. Both types have quick make-and-break precision mechanism, unit base for each pole 60 Amps. and over. Complete range of knockouts, attractive machine-gray finish. Listed as standard by Underwriters' Laboratories, Inc.

TYPE "A" — Range 600 Volts and less; 30 to 1200 Amps. Horsepower rated. Fusible or no-fuse types, with Interlocking Cover (cannot be opened when switch is "ON".)

TYPE "C" — Range 600 Volts and less; 30 to 600 Amps. Horsepower rated. Fusible or no-fuse types. Cover non-interlocking with snap latch; may be fastened by padlock. Highly serviceable switch for average requirements; priced lower than TYPE "A".

Mail this Coupon

To Arrow-Hart & Hegeman Electric Company, Hartford 6, Conn.

Send us your new Catalog C-10 of Enclosed Switches — Types "A", "C" and "D" — and other Service Equipment.

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THE ARROW-HART & HEGEMAN ELECTRIC COMPANY, HARTFORD, CONN., U. S. A.

Here's what the

NATIONAL ELECTRICAL WHOLESALERS' ASSOCIATION

says about

Certified Ratings

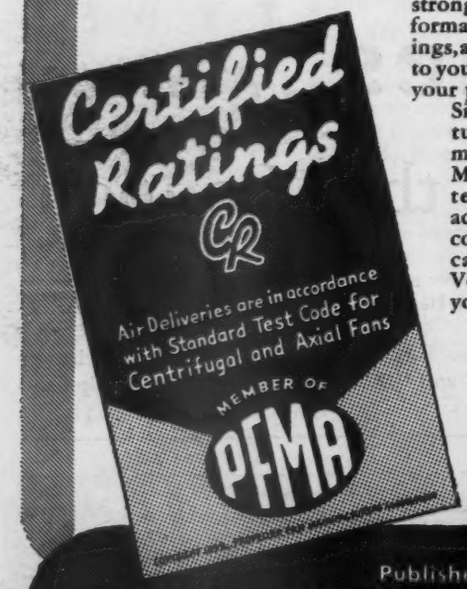
At its May, 1947 meeting the National Electrical Wholesalers' Association adopted a resolution concerning the use of the Certified Rating Label for propeller fans . . . the label which assures the purchaser that the propeller fan he buys will perform as specified.

The resolution states in part: "It is the consensus of the Fan and Ventilating Committee of N.E.W.A. that the standard Test Code is a beneficial and constructive program in the attic and ventilating fan industry."

This is important to YOU . . .

This action of the N. E. W. A. gives strong support to the assured-performance principle of Certified Ratings, and emphasizes the importance to you of following this principle in your purchasing of propeller fans.

Sixteen of the leading manufacturers of propeller fans are members of the Propeller Fan Manufacturers' Association, testing and rating their fans according to the standard test code established by the American Society of Heating and Ventilating Engineers. This gives you ample opportunity to select a *certified* propeller fan on your next purchase.


Certified Ratings
Air Deliveries are in accordance with Standard Test Code for Centrifugal and Axial Fans
MEMBER OF
PFMA

. . . LOOK FOR the P. F. M. A. Certified Rating Label on the propeller fans you buy!

Published by

PROPELLER FAN MANUFACTURERS' ASSOCIATION

5-208 General Motors Building

Detroit 2, Michigan

Manufacturers News

AMERICAN STEEL & WIRE APPOINTMENTS

H. H. Bullen has been appointed manager of western district electrical products sales, of American Steel & Wire Company. His territory covers the states of Illinois, Indiana, Iowa, Wisconsin, Nebraska, Wyoming, Colorado, New Mexico, Minnesota, Montana, North Dakota, South Dakota, Missouri and Kansas. He will continue to maintain his headquarters in Chicago.

John R. Gaut has been appointed assistant manager of Chicago district operations. Nelson W. Dempsey has been named general superintendent at Waukegan Works to succeed Mr. Gaut, while Vernon L. Strohm has been moved up to the position of division superintendent of wire mills to fill the vacancy left by Mr. Dempsey.

WESTINGHOUSE CHANGES

Westinghouse Electric Corporation, Pittsburgh, Pa., has announced the appointment of F. D. Weatherholt as assistant industrial sales manager with headquarters at East Pittsburgh.

Edward G. F. Arnott has been named as assistant director of research for the Westinghouse Lamp Division, Bloomfield, N. J.

George E. Richardson has been appointed assistant to the manager of the Feeder Division, Westinghouse Electric Corp.

Bernard Lester, assistant manager, headquarters, industrial sales department, has retired after 43 years of service with Westinghouse. Following his retirement, Mr. Lester is opening his own consultation service in the sale and distribution of machinery and equipment for managers of medium-sized and small industrial builders and suppliers.

W. E. WILSON ELECTED V. P. OF ACME ELECTRIC

At the last meeting of the board of directors of Acme Electric Corporation of Cuba, New York, Wm. E. Wilson, who has been sales manager of the company for the past three years, was elected to the office of vice president in charge of sales. Before joining Acme, Mr. Wilson was associated in Washington with the War Production Board and before that he was with Jefferson Electric Co.

Charles T. Little has been appointed

Engineered LIGHTing Products by GLOBE

The name of Globe Lighting Products Inc. has become synonymous with expert engineering and the finest in Design, Craftsmanship and materials. Leaders in lighting of distinction for over a quarter century.

FLUORESCENT
INCANDESCENT
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COMMERCIAL
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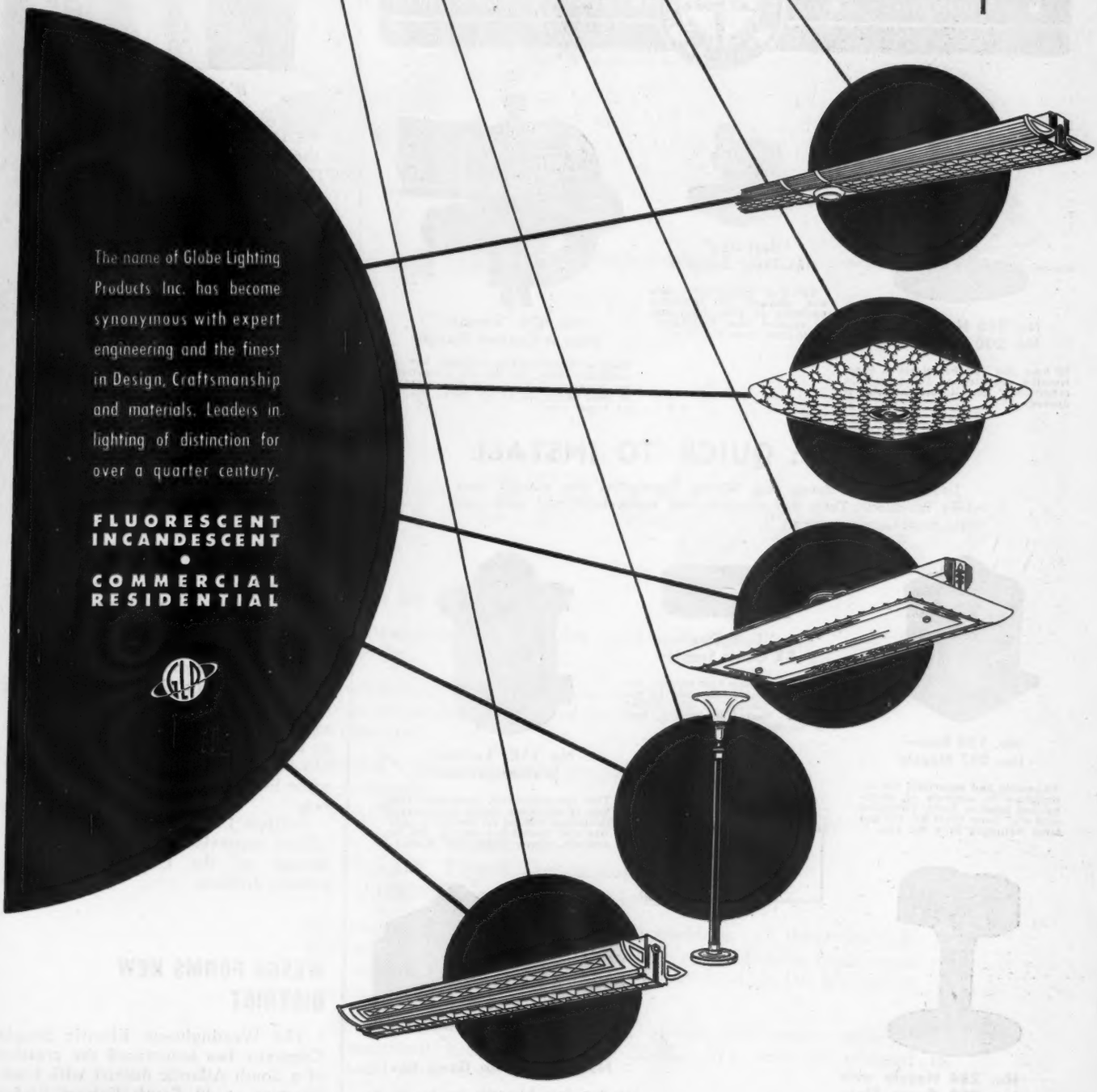

WRITE TODAY for Globe's two, colorful catalogs covering commercial and residential lighting.

GLOBE

Established for over a quarter century

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LIGHTING PRODUCTS, INC.
BROOKLYN, NEW YORK • LOS ANGELES, CALIF.
NEW YORK showrooms: 16 EAST 40th STREET

FULLMAN **Latrobe** PRODUCTS

FLOOR BOXES — WIRING SPECIALTIES

No. 280 Nozzle with No. 200 Cover Plate

10 Amp. 250 Volt Receptacle in Brass Housing, mounted on ½" brass pipe extension 3" long—longer extension if desired.

"Bull Dog" Insulator Support

"Bull Dog" Supports are safe and efficient for fastening porcelain or glass insulators to exposed steel framework. Four sizes, from 1" to 2½".

No. 470 "Latrobe" Pipe or Conduit Hanger

Made of highest grade malleable iron and cadmium plated, the No. 470 is unexcelled for hanging ½", ¾" and 1" pipe or conduit to steel beams up to ⅜" thick. No. 471 for larger pipe.

"LATROBE": QUICK TO INSTALL

"Latrobe" Floor Boxes and Wiring Specialties are quickly and easily installed. They are durable and economical and give top-flight, trouble-free service.

No. 150 Box— No. 207 Nozzle

Adjustable and watertight for installation in concrete or wood-finished concrete floors. Furnished with 4½" Cover Plate No. 242 and large Adjusting Ring No. 215.

"Bull Dog" BX Cable Staples

Millions of these high quality, dependable staples are now in use in every section of the United States. Packed in cartons, kegs or barrels.

No. 110 "Latrobe" Watertight Box

This non-adjustable, watertight Floor Box is extremely simple and compact in design, making for speedy installation and trouble-free service. 208 Receptacle. Cover Plate 3½" diam.

Sold Only Through Wholesalers

No. 284 Nozzle with No. 200 Cover Plate

Neat, compact-fitting and extremely durable, this Duplex Receptacle Nozzle comes with either ½" or ¾" brass pipe extension.

No. 252-R Two Gang Box

This Two Gang Adjustable Box has our No. 208 Receptacle in one section. One Cover Plate has ½" Flush Brass Plug; other has 2" Flush Brass Plug.

FULLMAN MANUFACTURING CO.
LATROBE . . . PENNSYLVANIA

W. E. WILSON

direct factory representative in charge of the New York City office located in 4717 Grand Central Terminal Building.

GENERAL ELECTRIC APPOINTMENTS

F. K. McCune has been appointed assistant to the general manager of the apparatus department of General Electric Co. He will assist the general manager on administration and organization matters.

Albert J. Brock has been named assistant manager of construction materials sales for G-E. He is succeeded as manager of the G-E Home Bureau by I. P. Pruitt.

J. H. MacPhee has been appointed wiring device representative in the Northeastern district.

Announcement has been made of the appointments of James W. Arthur as North Central district representative and Allen A. Olson as Pacific district representative for G-E wire and cable.

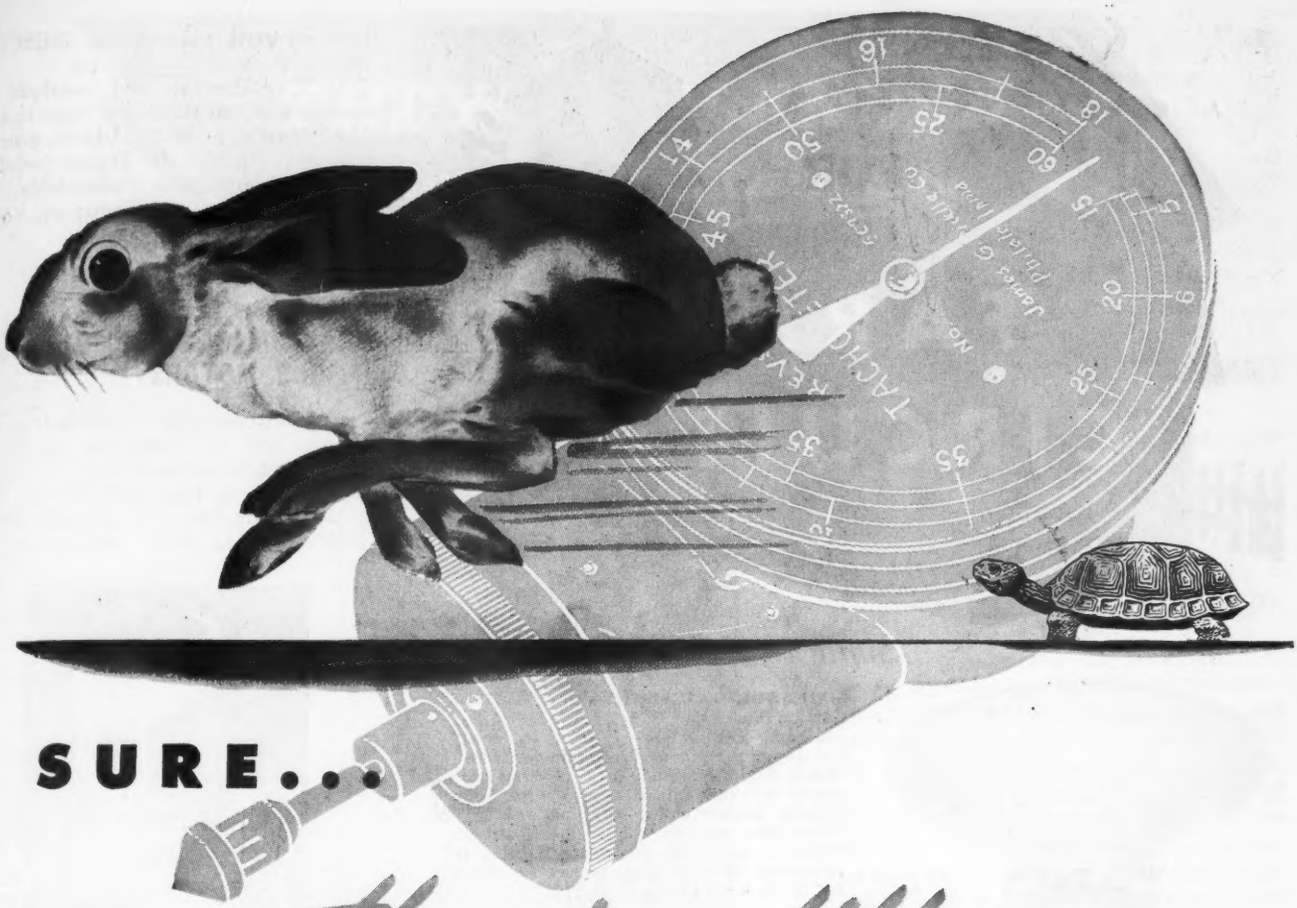
John O. Wiley, who was formerly assigned to the Minneapolis territory as representative for conduit products, has been named representative for the same line in Indiana and northern Illinois.

William J. Kern has been named assistant supervisor of the field service section of the Company's product service division.

WESCO FORMS NEW DISTRICT

The Westinghouse Electric Supply Company has announced the creation of a South Atlantic district with headquarters at 40 South Calvert Street, Baltimore, to supervise company operations in Maryland, Virginia and the District of Columbia. The territory formerly was covered by the Middle Atlantic District, with offices at Philadelphia.

Company branches at Baltimore, Washington, Richmond, Norfolk and Roanoke are included in the new district, which will be headed by C. R.



SURE... there's a difference

. . . in speeds to be measured.

And we have instruments to help solve *your* speed-measuring problems accurately . . . dependably.

Covering a wide range of speeds, each Biddle Instrument is designed to do a specific job . . . and do it well. Included among the Biddle line are:

- "FRAHM" Resonant-reed Permanent Mounting Tachometers
- "FRAHM" Resonant-reed Portable Hand Tachometers
- "JAGABI" Tachoscopes
- "JAGABI" Type-A Tachometers (centrifugal)
- "JAGABI" Speed Indicators (chronometric)

Accuracy . . . dependability . . . ruggedness . . . these are the built-in advantages that you get with every Biddle Instrument . . . advantages equally important in the field, in the laboratory, or on the production line.

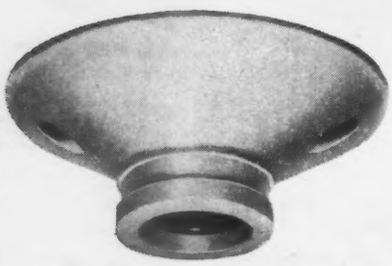
The Biddle Instruments listed above and many others are described fully in Bulletin 35-EC. We will be pleased to send you a copy.

JAMES G. BIDDLE CO.

Electrical & Scientific Instruments

1316 ARCH STREET, PHILADELPHIA 7, PA.

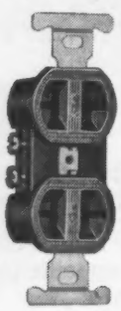
BUILT TO R.E.A. SPECIFICATIONS



KEYLESS CEILING RECEPTACLES—WHITE PLASTIC—Catalog Nos. 275-3, 275-4. 660V-600V. For 3¼" and 4" round boxes. Extra ½" oversize design permits safety margin for installation. Rigid terminals—large binding head screws will take No. 10 copper wire. Light weight; advantage in shipping and handling. Not subject to mechanical stresses found in porcelain. Breakage reduced to minimum. Washer head screws furnished for quick mounting.

TOGGLE SWITCHES, T-RATED – 10 Amp., 125V, T; 5 Amp, 250V. Single pole brown bakelite, Catalog No. 400. Three way, Catalog No. 403. In ivory, Catalog Nos. 400-I, 403-I. Cup Dimensions: 1⅜" long, ⅞" wide, 1" deep. Small, compact body, for easy wiring.

DUPLEX RECEPTACLE "T" SLOT—15 Amps-125V; 10 Amps-250V. Side wired, brown bakelite, Catalog No. 300. Ivory Catalog No. 300-I. Phosphor bronze contacts for durability.



BUILT with rigid adherence to the specifications of the Rural Electrification Administration, where they apply, these Slater Lifetime wiring devices admirably fulfill the requirements of the program to electrify rural homes.

These lifetime devices are engineered and produced for long-term service under heavy usage. Individual packing minimizes stock loss for wholesalers, contractors and dealers. Distributed only through wholesalers.

All items are listed and approved by Underwriters' Laboratories, Inc.

Slater
ELECTRIC & MFG. CO.
WOODSIDE, NEW YORK
Lifetime wiring devices

Lee, formerly manager of WESCO's branch at New Orleans, La.

J. T. Ridgeway will continue as manager of the Baltimore branch, and J. F. Myers as Middle Atlantic district manager. Under Mr. Myers' jurisdiction are branches at Philadelphia, Allentown Reading, Williamsport, York, Pa., and Wilmington, Del.

FRANK MASON PROMOTED BY U. S. MOTORS

Announcement has been made of the appointment of Frank M. Mason as vice president in charge of the Atlantic plant of U. S. Electrical Motors, Inc.

Mr. Mason joined the organization in 1930 and has been successively in

F. M. MASON

charge of the test department, service department; then assistant chief engineer, Chicago district manager, and manager of the Brooklyn assembly plant.

He will make his headquarters at the U. S. Motors' plant at Milford, Conn.

SYLVANIA APPOINTMENTS

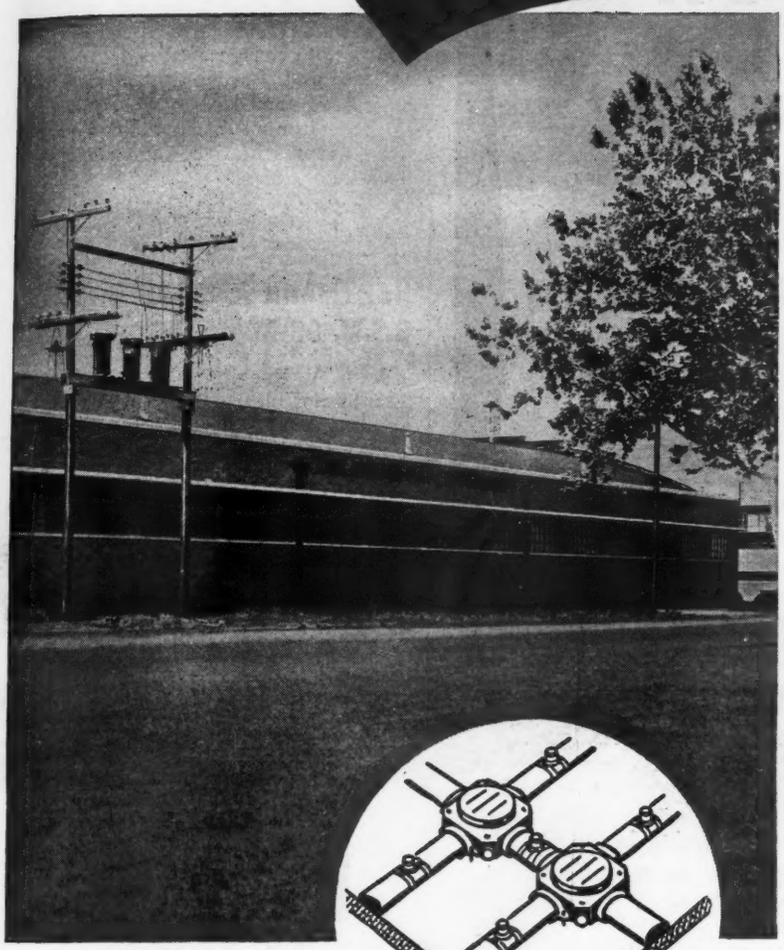
George R. Sommers, formerly Pacific Coast manager of lighting products for Sylvania Electric Products, Inc., has been appointed director of sales for all product divisions of the company in that area. In his new capacity Mr. Sommers will be responsible for directing all sales activities, distribution policies and merchandising programs for the West Coast territory.

Garlan Morse and Frederick W. Fulle have been appointed merchandising managers of the Lamp Division, respectively of Sylvania Electric.

ALLIS-CHALMERS APPOINTMENTS

Election of W. A. Roberts and W. C. Johnson, executive vice presidents of Allis-Chalmers Mfg. Co., to the firm's board of directors has been announced.

THEY'VE PLANNED
for tomorrow's wiring today

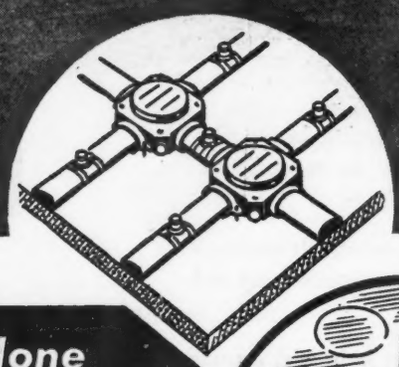


AT OKLAHOMA PAPER COMPANY

Planning a paper plant—like planning any other building—is a struggle with obsolescence from the time the first pencil mark goes on the drawing board. And it's just this kind of swift old age which the Oklahoma Paper Company was fighting when it equipped a brand-new addition to its Oklahoma City plant with General Electric Fiberduct underfloor raceways.

This kind of planning—in anticipation of changes in floor arrangement and operations—calls for an electrical system that can be changed to meet any condition, at any time, at little expense. At the Oklahoma Paper Company, flexibility like this is provided by a network of Fiberduct raceways laid on 14-foot centers in the concrete floor. With this ample system, new outlets can be installed practically anywhere in the floor simply by tapping into the raceway. New circuits can be added anytime, without ripping up floors.

In the planning stage of any project, consider G-E Fiberduct raceways for their adaptability to changes in building layout, to new demands on electrical capacity, and to new types of electrical equipment. Insist on G-E Fiberduct raceways for buildings that must stay electrically young. If you're interested in knowing more about this adaptable system, contact your nearest General Electric merchandise distributor, or write to Section C2-318, General Electric Company, Bridgeport 2, Connecticut.



How it's done

Noncorrosive, nonmetallic Fiberduct raceways, laid in monolythic or slab and fill constructions, can be laid out in patterns as simple or complex as present and future building facilities may require. Accessible handholes at junctions permit easy installation of new circuits. To provide a new outlet after the floor is laid, merely make a small opening in the floor over the raceway, pull the wires through, and install the outlet. The job is done with no interruption of the building's facilities—and at low cost.

GENERAL ELECTRIC

FIBERDUCT
Raceways
FOR ELECTRICAL FLEXIBILITY

The Makers and Distributors of

CHAMPION

FLUORESCENT and *Incandescent*
LAMPS

For Every Industrial Service
Urge You to Make the Most of

PLANNED LIGHTING

For better products and increased production at lower overall cost *plan your lighting* before you buy lamps or fixtures.

CHAMPION helps you:

1. By supplying the finest quality, longest lasting lamps that forty-eight years of specialized experience in the manufacture of lamps for industry can produce.

2. By concentrating on low overhead and direct sale through qualified industrial suppliers to assure you minimum lamp and lighting cost.

3. By stationing trained lighting experts in industrial centers to furnish prompt, dependable recommendations on all lamp or lighting problems.

Let us mail you a copy of the Champion Maintenance Manual "A" It's full of useful hints on how to make the most of *planned lighting.*

CHAMPION LAMP WORKS
Lynn, Massachusetts
A DIVISION OF CONSOLIDATED ELECTRIC LAMP CO.

Mr. Roberts is in charge of the company's tractor division, and Mr. Johnson the general machinery division.

James M. White, vice president in charge of manufacturing, has announced his resignation effective January 17, but will remain in an advisory capacity to President Walter Geist for the next six months.

Manufacturing operations will continue under the direction of Fred S. Mackey, general works manager in charge of all general machinery plants, and Hugo W. Liebert, general works manager in charge of all tractor plants.

George H. Carden and T. G. Smith have been named respectively manager of the Baltimore district office and resident representative at Beaumont, Texas.

HARTMANN NAMED G.S.M. OF ROEBLING

John A. Roebling's Sons Company, Trenton, N. J. has announced the appointment of E. George Hartmann as general sales manager.

Mr. Hartmann, who brings to his new position over 29 years experience

E. G. HARTMANN

in the wire field, has been associated with the Roebling Company since 1940. He is a member of the Wire Association and the American Iron and Steel Institute.

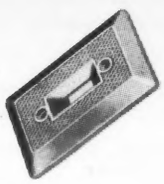
SNYDER APPOINTMENTS

Wally B. Swank, former sales manager of the E. F. Johnson Co., Waseca, Minn., has been appointed sales representative of Snyder Manufacturing Company, Philadelphia, for New York State. Mr. Swank will maintain offices in Syracuse, N. Y.

Charles E. Anderson has been named as representative for a territory which includes Michigan, Ohio, Southern Indiana, Kentucky, Western Pennsylvania and the western part of West Virginia. He will maintain headquarters in the Rockefeller Building, Cleveland, Ohio and also in Cincinnati.

GET ALL *Five* FEATURES

USE PORCELAIN FOR EVERY WIRING NEED



Porcelain Protected Wiring Systems are ADEQUATE because they have higher current carrying capacities. They're SAFE because porcelain is short-proof, shock-proof, rust-proof and corrosion-proof. Porcelain is PERMANENT as proved by installations in use for over 50 years. Porcelain systems are FLEXIBLE — readily extended, with easy accessibility to open feeders. Porcelain systems are ECONOMICAL, as shown by their adaptability to practically all wiring plans, their low cost, and time-saving features.

***BE Sure* WITH**

PORCELAIN PROTECTED WIRING SYSTEMS

★ ILLINOIS ELECTRIC PORCELAIN CO. *Macomb, Ill.*

★ PORCELAIN PRODUCTS, INCORPORATED *Findlay, Ohio*

★ SPECIALTY PORCELAIN WORKS *East Liverpool, Ohio*

★ SUPERIOR PORCELAIN COMPANY *Parkersburg, W. Va.*

★ UNIVERSAL CLAY PRODUCTS COMPANY *Sandusky, Ohio*

POWDER OPERATED CONSTRUCTION TOOL

Drives Threaded Studs 3 Inches into Concrete INSTANTLY!

Several of the 30 threaded and unthreaded studs available with the DRIVE-IT tool.

Stud Holding Power Between 2000 and 6000 Lbs.

.38 Cal. (top) and .22 Cal. (bottom) DRIVE-IT TOOLS

"YOU won't believe it until you see it operate," is the almost unanimous opinion of contractors who have adopted the amazing new Powder-Power tool, DRIVE-IT, to drive steel studs through wood or metal into concrete.

HOW IT WORKS

The DRIVE-IT tool employs a small powder charge encased in a standard cartridge to drive studs 3" into concrete and through 5/8" steel. The desired stud and cartridge are placed in the tool. The muzzle of the tool is placed on the spot where the stud is to be driven and the tool is forced forward. This detonates the explosive charge, driving the stud into concrete or steel with such force the stud actually fuses with aggragate or metal. Up to 6000 lbs. force is required to pull DRIVE-IT studs from ordinary concrete.

UNLIMITED APPLICATION

The DRIVE-IT tool offers unlimited application for all contractors:

ELECTRICAL: For anchoring conduits, switch boxes, cables, etc., to concrete and masonry.

PLUMBING AND HEATING: For hanging pipe, heating ducts, from concrete ceilings or walls.

PLASTERING: For suspending ceilings or "nailing" wood firring to concrete.

GENERAL: "Nailing" steel window and door frames, wood sleepers, etc., to concrete.

ABSOLUTELY SAFE

DRIVE-IT, the **original** powder-operated tool, functions without recoil shock. It is **absolutely safe** and cannot be discharged even if dropped several floors.

Write for Demonstration

The DRIVE-IT distributor in your region will be glad to show you the .38 cal. and .22 cal. models in operation. Write for complete DRIVE-IT information, name and address of your nearest distributor.

POWDER POWER
TOOL CORPORATION
FOOT OF S. W. WOODS STREET (DEPT. G)
PORTLAND 1, OREGON

GENERAL CONTROLS PROMOTIONS

General Controls Co. of Glendale, California, has announced the appointment of E. B. Maire as sales manager of the Midwestern, Southern and Eastern branch offices.

F. E. Weldon has been named factory branch manager of the New York office, 101 Park Ave., serving the states of New York, New Jersey and Connecticut.

C. G. McCarthy will be Detroit factory branch manager, covering Michigan, sections of Ohio and Canada.

Don S. Bentley has been appointed factory branch manager in Los Angeles, serving Southern California, Arizona, sections of Nevada, New Mexico and Texas.

•

Appointment of Eamonn D. A. Geoghegan as factory manager of the Chicago plant of **Solar Manufacturing Corporation** at 4501 South Western Blvd., as been announced.

Mr. Geoghegan comes to Solar from Tobe Deutschmann Corp., Canton, Mass. where he was chief engineer. He was previously connected with Polymet Manufacturing Corp., Radio Corporation of America and Sprague Electric Company, in various engineering and production capacities.

•

R. A. Lundbeck Company, 1900 University Avenue, St. Paul, Minn., has been formed to take over the representation of the **Allen-Bradley** line of motor controls formerly handled by Savage-Girton Company of the same city. This company will cover Minnesota, North Dakota, South Dakota, and the western counties of Wisconsin.

•

Purchase of **American Relay & Controls, Inc.,** 2555 West Diversey Avenue, makers of electrical relays, switches, and specialized controls, by **David T. Siegel,** Chicago manufacturer, was announced recently. The firm has also moved to a new location at 4900 West Flournoy Street, Chicago, Ill.

•

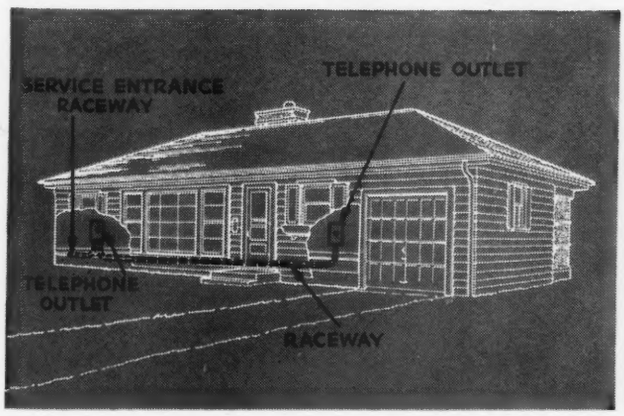
The Wilson Welder and Metals Company, Inc., New York, has appointed the industrial Air Products Company as its exclusive electrode distributor in the state of Oregon. The main office of this new distributor is located at 3200 N.W. Yeon Avenue, Portland, Oregon.

•

The Pyle-National Company of Chicago, has announced the appointment of Peter G. Holliday as works manager. He was formerly vice president of Standard Cap and Seal Corporation, Chicago.

Bertram Weber—Architect

A TELEPHONE RACEWAY COMES WITH THIS COTTAGE



A raceway for concealing telephone wires is a feature which means a lot of convenience to any new home — and added profit for you.

Installed within walls during construction, a few sections of pipe or electrical conduit will carry telephone wires to conveniently located outlets. A raceway eliminates the need for exposed wiring on walls or woodwork and assures modern built-in telephone outlets.

Remember — NO ELECTRICAL CONTRACT IS REALLY COMPLETE UNLESS IT INCLUDES A RACEWAY FOR TELEPHONE WIRING FACILITIES.

BELL TELEPHONE SYSTEM

SORGEL AIR-COOLED TRANSFORMERS

Made by the Pioneers of **Dry-Type** *Transformers*

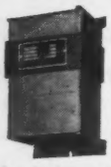
Over 30 Years' Experience

This is our Principal business— not a side line

Liberal Design
Steel Encased
Solderless Terminals
Connection Compartment

Leaders— with the latest improvements and refinements.

A size and type for every purpose. 1/4 to 1000 Kva. All voltages. 115 volts to 15,000 volts.



¼ Kva Single Phase 460/230 to 115 volt

100 Kva. Single Phase Floor Mounting Type.

SORGEL ELECTRIC CO., 836 W. National Ave., Milwaukee 4, Wis.

Pioneers in the development and manufacturing of Air-Cooled transformers.

Larry M. Rudbeck, with the Electrical Division of Allis-Chalmers since release from the Navy two and one half years ago, is now associated with **Homer G. Hall** of Princeton, Ind. Mr. Rudbeck will be located in Indianapolis and will handle the various lines represented in the Indianapolis and Louisville areas. Mr. Hall will continue operations with headquarters at Princeton.

•

Cutler-Hammer, Inc., Milwaukee, has announced new and expanded quarters for their San Francisco sales office and manufacturing plant at 2130 Third Street. J. M. Cook is San Francisco district sales manager.

•

Max Weber, designer and patentholder of the Roto-Beam air radiant circulators, has announced that he will personally direct the manufacture and distribution of this line in the future. Mr. Weber takes over from Climax Industries, Inc., Clinton, Iowa, former licensee under Mr. Weber's patents. The new address of **Roto-Beam** is 1755-57 N. Keeler Ave., Chicago, Ill.

•

Graybar Electric Company appoints E. H. Fohrman as district operating manager at St. Louis.

•

R. H. Jewell has been appointed as sales representative in the newly opened New York City sales office of the **Bright Light Reflector Company.**

•

The American Coach and Body Company, Cleveland, Ohio, has announced the appointment of L. Duane Petee as body designer.

•

Appointment of Theodore I. Leston as vice president in charge of production, of **Eutetic Welding Alloys Corporation,** N. Y. has been announced. He became director of production in the late summer of 1947, and now assumes full charge of manufacturing at 110 Duane Street, New York, where the company's newly-equipped plant is located.

•

Sykes Electric Mfg. Company has moved from the old Chicago location to new and larger quarters at 3905 Wesley Terrace, Schiller Park, Ill.

•

Brown Company has announced the appointment of William F. Bishop as sales representative on the Eastern seaboard. Mr. Bishop formerly held various positions in technical sales.

BE SURE IT'S A

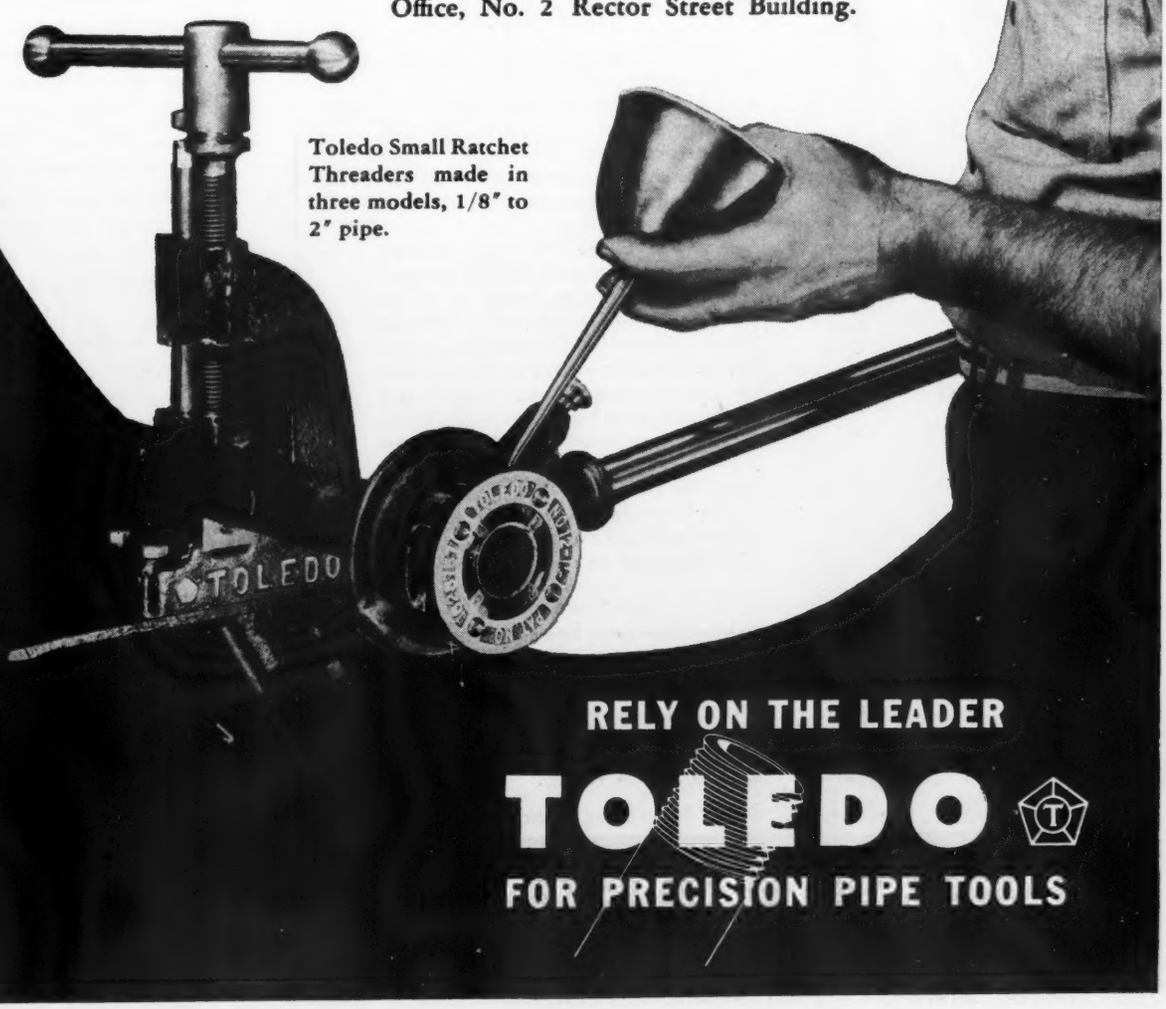
Genuine

TOLEDO THREADER

YOU'LL SAVE TIME...CUT COSTS!

Put genuine TOLEDO Pipe Tools in the hands of your mechanics—they'll do *better work, faster* and *cut costs!*

These are the easy-threading tools preferred by experienced pipe fitters for nearly half a century. They're Toledo-engineered for accuracy . . . and day-in and day-out dependability. There's satisfaction on the job . . . when you tool up *right* with TOLEDOS! The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office, No. 2 Rector Street Building.

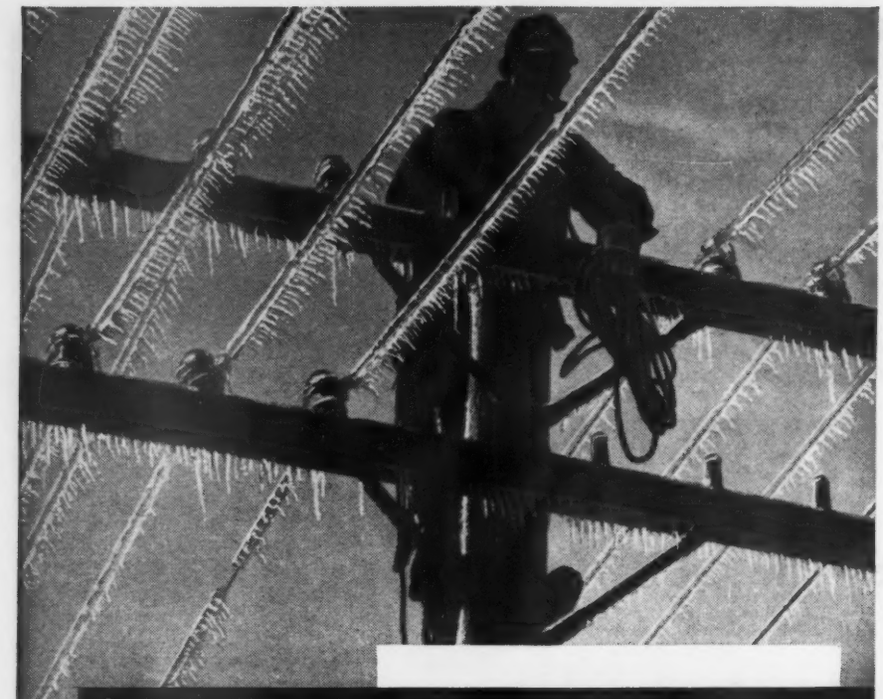


Toledo Small Ratchet Threaders made in three models, 1/8" to 2" pipe.

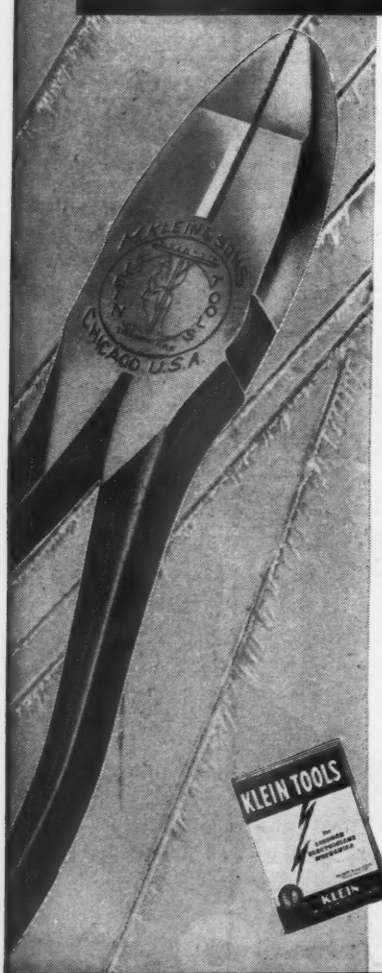
RELY ON THE LEADER

TOLEDO

FOR PRECISION PIPE TOOLS



KLEIN PLIERS!



... PREFERRED BY LINEMEN

Wherever there are linemen ... whatever the job—tough or routine—you'll find Klein Pliers.

There's good reason for this widespread preference that began when the electrical industry was in its infancy and has continued on through the years.

Linemen know they can depend upon the quality and performance of Klein Pliers. Drop forged from the finest alloy steel, each pair is individually tempered and tested—has the proper balance—just the right spring to the handles to minimize hand fatigue. A fitted hinge keeps jaws perfectly aligned—the carefully matched knives cut swiftly, surely and stay keen for years.

The complete Klein line includes pliers for every use. Your supplier will fill your order as quickly as possible.

Ask Your Supplier

Foreign Distributor: International Standard Electric Corp., New York

A copy of the Klein Pocket Tool Guide, showing the Klein line and containing valuable tool information, will be sent on request.

Since 1857

Mathias KLEIN & Sons

Established 1857 — Chicago, Ill., U.S.A.

3200 BELMONT AVENUE, CHICAGO 18, ILLINOIS

HANDLING ALUMINUM WIRES

[FROM PAGE 91]

Western Union style splices may be easily soldered. The aluminum should be preheated with an iron or torch and then fluxed. Subsequent operations are no different than accepted soldering practices.

The following procedure has been used successfully in making soldered splices on stranded conductors.

1. The cable ends to be joined are cut perpendicular to the cable axis, the insulation is removed, and asbestos wraps applied in accordance with normal procedure, care being taken not to nick the strands while removing the insulation.

2. The two outer layers of strands are stepped back, the maximum step on the outer layer being equivalent to about one-quarter of the length of the split connector sleeve to be used. The remaining strands are fanned out. Stepping requires little time and may be accomplished satisfactorily with a small tube or pipe cutting tool. The advantage of stepping lies in the fact that it allows deeper, more uniform penetration of flux and solder. Where stepping is found impractical, the spaces between the ends of the strands which are closed by burrs from sawing should be opened with a sharp pointed tool. Ends and exposed surfaces should be cleaned and wire brushed.

Electrical test results on splices made using both methods of end preparation are very good. However, on dissection of splices, the stepped samples give the appearance of being a more substantial job.

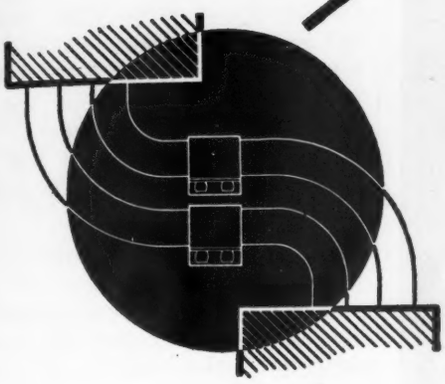
3. The conductor is heated *slowly* with a torch to insure uniform heat penetration throughout each layer of strands. The proper temperature is that at which an XA-803 solder stick will just melt when brought in contact with strand surfaces. Higher temperatures should be avoided in order not to damage the flux.

4. No. 62 flux is applied over the strands with a brush, working the flux into all interstices and the ends of the cable. To facilitate flow, the flux may be thinned with about 25 percent by volume of ethyl or methyl alcohol, or it may be heated slightly.

5. The split connector sleeve (tinned copper) is placed in position. It should fit loosely to allow solder to flow freely around strands and through interstices. About $\frac{1}{8}$ inch space is allowed between conductor ends.

6. Solder is ladled at a pot tempera-

"WHAT'S THE QUICKEST, CHEAPEST WAY OUT OF CONDUIT TIGHT SPOTS?"



"Split couplings—made by O.Z."

When you're faced with that tough coupling job where it's impossible to screw "L" conduits into ordinary fittings . . . what you need is the O. Z. Split Coupling. Simply butt the conduit ends within the opened Split Coupling, tighten the two nuts and you have a permanent joint. No turning or twisting is necessary *—installation costs are kept to a minimum.*

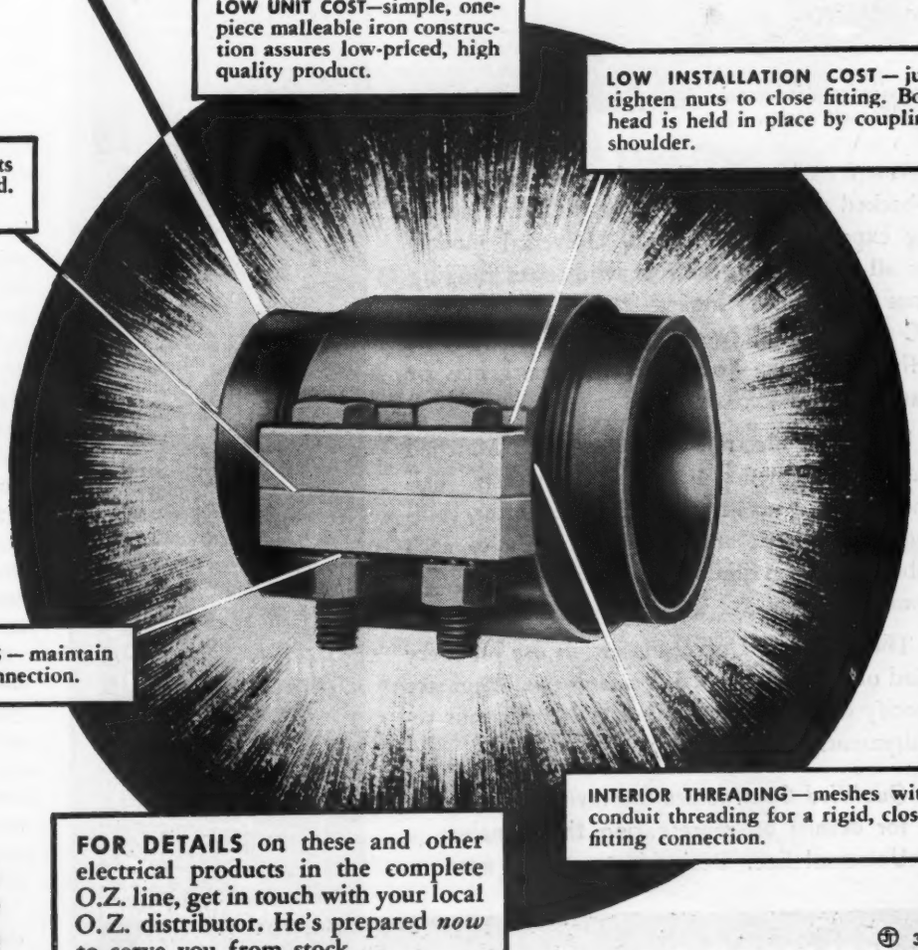
Now available for conduit sizes ranging from 5" *down to* ½", O. Z. Split Couplings give you these advantages:

LOW UNIT COST—simple, one-piece malleable iron construction assures low-priced, high quality product.

LOW INSTALLATION COST — just tighten nuts to close fitting. Bolt head is held in place by coupling shoulder.

TIGHT CLOSING — flange fits tight together when closed. Keeps out dust and dirt.

UL APPROVAL



SPRING STEEL LOCK WASHERS — maintain pressure for permanent connection.

INTERIOR THREADING — meshes with conduit threading for a rigid, close-fitting connection.

THEY'RE O. K. IF THEY'RE O.Z.

FOR DETAILS on these and other electrical products in the complete O.Z. line, get in touch with your local O. Z. distributor. He's prepared *now* to serve you from stock.

3493

O.Z. ELECTRICAL MANUFACTURING COMPANY
262 BOND STREET · BROOKLYN 2, N. Y.

CONDUIT FITTINGS · CABLE TERMINATORS · GROUNDING DEVICES
CAST IRON BOXES · SOLDERLESS CONNECTORS · POWER CONNECTORS

ELECTRIC POWER
for any purpose

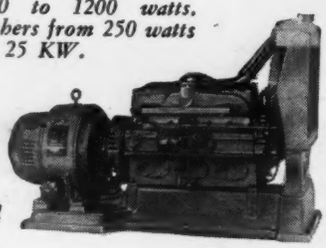
with a . . .

Universal
"MATCHED UNIT"

ELECTRIC PLANT

PORTABLE • STAND-BY • STATIONARY MODELS

Hand portable models 700 to 1200 watts. Others from 250 watts to 25 KW.



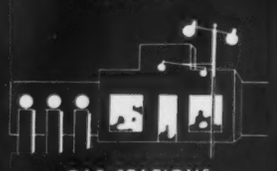
Six-cylinder Universal 12,500 watt series.

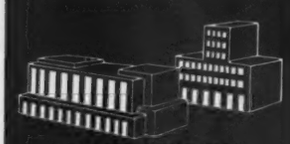
• America's broadest line of generating plants —backed up by 50 years' designing and building experience. There are Universal models for all power requirements, with sizes ranging from one to six cylinders—250 to 25,000 watts, AC or DC. All types of controls—manual to fully automatic—for portable, emergency or stationary service.

Universal Electric Plants are of "Matched Unit" construction—assuring perfectly balanced units. This means engine, generator, cooling system, etc., are matched exactly to each other for maximum reliability—long, economical service.

Thousands of Universals are in use on every kind of powering job. Let a Universal Engineer specify the type and size best suited to your requirements. Write today.

Qualified Contractors **are invited to write for details on representing the complete Universal line. Desirable territories open.**





UNIVERSAL MOTOR COMPANY
FOUNDED 1898
438 UNIVERSAL DRIVE • OSHKOSH, WISCONSIN

ture of from 550° F. to 600° F. into the connecting sleeve and allowed to flow freely to tin the conductors. (This temperature range is apparently higher than the recommended 500° F. maximum for efficient fluxing. However, allowance has to be made for temperature drop caused by ladling and by solder contact with conductor strands, especially in large cables.) When the conductors are tinned, and while the solder is still fluid, the ends are pushed tightly together and the connector is closed with pliers.

7. Ladling is continued and the splice finished per standard procedure.

Soldered Terminals

The application of lugs is a standard operation provided that the fluxing procedure and soldering temperatures described above are closely followed. Copper lugs tinned with XA-803 solder should be used. Stepping back of strands is not necessary.

Where cable ends are free, the following method of applying terminals may be used to advantage.

1. The cable end to which the lug is to be applied is cut perpendicular to the cable axis, the insulation is removed and asbestos wraps applied in accordance with normal procedure, care being taken not to nick the strands while removing the insulation.

2. The interstices which are closed by burrs should be opened with a sharp pointed tool. Ends and exposed surfaces should be cleaned and wire brushed.

3. Strands are heated for from 15 to 30 seconds, depending on conductor size, by dipping into a solder pot between 550° F. and 600° F. On removing, excess solder is shaken off to leave the surfaces and interstices clean for fluxing.

4. The conductor is dipped into a small container of flux and allowed to remain till boiling stops. The flux may be thinned with about 25 percent by volume of ethyl or methyl alcohol to facilitate flow, or it may be heated slightly. Fresh flux should be used for each termination.

5. Excess flux is shaken from the conductor and it is immediately immersed in the solder to tin the strands.

6. The lug is tinned and filled with molten solder.

7. The conductor end is slipped into the lug and held till the solder sets.

The foregoing procedures represent practical methods of soldering aluminum conductors. Splices and terminations made in accordance with these procedures are satisfactory.

Copper to aluminum splices may be made without difficulty. The XA-803 solder and No. 62 flux serve equally well for both metals.

Compression

Compression designs vary with the manufacturers. One type compresses the barrel of the fittings to a hexagonal shape, another remains round, while still another relies on a deep impression or indent. Each of the types have given good results.

It is necessary, however, to use a good oxidation inhibiting compound in joints of this type.

These compounds should be forced well up into the strands and should completely coat all surfaces before connections are made. Several manufacturers supply their fittings with inhibiters sealed in the barrel. When the fittings are worked on before compressing, the compound is forced up into and around the strands.

Alcoa No. 1 Joint Compound is an excellent material for this application. It has a continued dissolving action on the aluminum oxide film without attacking the aluminum. However, it is water soluble and if used, should be well protected by a thoroughly waterproof taping job.

Compression fittings should be made of E. C. grade aluminum for best results. The use of the same metal here eliminates difficulties which may arise from different coefficients of expansion and different rates of recovery after compression. The use of copper and the alloys of copper is undesirable since this metal and its alloys have lower coefficients of expansion than aluminum which causes the conductor to creep and the joint to loosen under continued load cycling. It has a greater recovery rate after compression than aluminum which leads to looseness and high resistances. Tests have shown that continued usage under these conditions results in internal oxidation and subsequent failure.

For increased efficiency of operation, compression fittings should have large contact area for low resistance; they should have sufficient mass for low temperature operation; and they should be plated to reduce dissimilarity between the aluminum and the equipment to which it is to be connected.

Bolted Connections

Bolted fittings are probably the most commonly used in present times because of the few tools and comparatively short time needed for installa-

RCA TUBES FOR INDUSTRY

RCA 833-A Power Tube

. . . available from your local RCA Tube Distributor

■ RCA has an industrial tube type for virtually every renewal requirement . . . and RCA tubes are directly interchangeable with other standard types.

For your convenience, RCA industrial electron tubes are now available directly from RCA or from your local RCA Tube Distributor.

The Fountainhead of Modern Tube Development is RCA

Send for New Guide

RCA 16-page booklet contains the data you need for the quick selection of power tubes, voltage regulators, thyratrons, ignitrons or gas rectifiers for any installation or application. Ask for Bulletin PG-101. RCA, Commercial Engineering, Section CT77, Harrison, N. J.

TUBE DEPARTMENT
RADIO CORPORATION of AMERICA
HARRISON, N. J.

You get
ALL THREE with a
BLACKHAWK
PIPE BENDER

Blackhawk Benders do MORE than bend pipe. They include a Porto-Power Hydraulic Unit that performs this triple job:

1 PIPE BENDING
Bends rigid conduit and pipe of all popular diameters. Saves need for elbows, couplings and extra cutting and threading.

2 MAINTENANCE and PRODUCTION
Porto-Power pushes, pulls, bends, presses, spreads, and clamps—pulls gears, lifts machinery and licks scores of other jobs.

3 SPECIAL JACK
Compact Hydraulic Ram works in all directions — at any angle. A versatile, safe, remotely controlled jack.

Blackhawk Mfg. Company,
Dept. P-2038 Milwaukee 1, Wis.
Mail Hydraulic Equipment catalog to:

Name_____
Company_____
Address_____

BLACKHAWK
WORLD'S LARGEST MANUFACTURER OF HYDRAULIC JACKS

tion. The multitude of designs are too numerous to mention. However, the majority of these will not operate successfully on aluminum. In selecting bolted fittings, the advice of a reliable manufacturer should be followed.

Generally, for successful operation, a fitting of this type must have high contact pressure, and large contact area. Pressures should be transmitted to the conductor through the medium of a large pressure bar or area. Set screw connections are definitely poor. The connector bodies and bolts should be rugged enough to exert considerable pressures.

Internal serrations are not recommended unless sufficient pressure can be exerted to bury these completely in the aluminum strands. If the conductor is allowed to ride on the knife edges of the serrations, contact area will be reduced considerably with resulting high resistance joints.

Two types of connectors which have given excellent results under cyclic loading at full rated load, "in air", are well worth mentioning here. The first, a heavy duty Burndy "NA-C", is a four-bolt tin-plated copper alloy assembly. It has exceptionally large contact area and is capable of exerting extreme pressure through the medium of its four bolts. The operating temperature of this lug is well below conductor temperature. The second, a Thomas and Betts "Tite-Bind", is a conical wedge type of cadmium plated copper alloy. The contacting surface of the cone is serrated and sufficient pressure is generated to drive these serrations into the aluminum. Excellent electrical contact is obtained in this manner. Operating temperatures of this lug are also below conductor temperatures.

Certain precautions are recommended for all connectors. Since they are usually of copper or copper alloy, they must be coated with zinc, cadmium or tin. The coatings should be sufficiently thick to afford adequate protection. An anti-oxide paste should always be applied before installing connectors. Various compounds are available and can be obtained from connector manufacturers; also, other compounds such as "No-Ox-Id Grade A Special" manufactured by the Dearborn Chemical Company and Alcoa "No. 1 Joint Compound" are satisfactory. As mentioned previously, however, the No. 1 Joint Compound is water soluble, and care should be taken to prevent its washing away.

The Underwriters' Laboratories, Inc. are now carrying out tests on bolted type connectors and will probably list those approved for use.

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ELECTRIC HAMMERS

3600 Powerful, Hard-Hitting Blows per Minute Speed Up—
Drilling—Cutting—Chipping in concrete and masonry

SYNTRON'S patented electromagnetic principle uses only one working part—the PISTON—producing high speed, hard-hitting blows that cut down job time.

Write for illustrated folder

SYNTRON CO.
690 Lexington, Homer City, Pa.

NEW EQUIPMENT

[FROM PAGE 102]

veloped. Starting, charging and shut down are performed automatically by the new unit. The m-g set and controls are contained in a cabinet 34 inches high, 24½ inches wide, and 12 inches deep. On a sloping top are mounted the timer, ammeter, and control switch for manual or automatic operation. A door in the front opens into a storage cabinet. Beneath the storage space are the m-g set and controls, which are ventilated by louvers located in the sides of the steel enclosure. It can be used on 220 or 440, 3 phase, 60 cycle power supply. General Electric Company, Schenectady 5, N. Y.

Anchor

A new positive-lock expanding anchor, known as Texanker, has been announced. It features ribbed blades for maximum strength with least weight, malleable iron construction for corrosion resistance and guide rails designed to insure proper balance of driving forces. They are available with a holding power of 6,000. 8,000, 10,000 or 12,000 pounds. All sizes have REA approval. Texas Foundries, Lufkin, Texas.

Electric Heater

A wall-type auxiliary electric heater has been announced. It has a grill of rust-proof satin finished aluminum and this flush-to-wall unit is particularly suited for the bathroom, or is adaptable for any other location where convenience of having extra heat is desired. It supplies heat by both radiation and convection and has Underwriters Laboratories approval. The vertical semi-cylindrical heating element consists of nickel-chrome wire supported on the outside of a ceramic post. The heater measures 10¾ by 20 inches, has a capacity of 1250 watts and operates on 115 volts, a-c or d-c. Electric Heating Department Westinghouse Electric Corporation, Emeryville 8, Calif.

POWER CIRCUIT TRANSFORMERS

•

THE most economical way of providing low voltage circuits for the lighting and operating of machine tools is to run a branch line from the power line, using a transformer to step down the voltage.

Dongan Transformers are being used for this purpose in industrial plants throughout the nation, reducing installation time and also conserving critical materials.

Capacities up to 37½ KVA. single and 3 phase.

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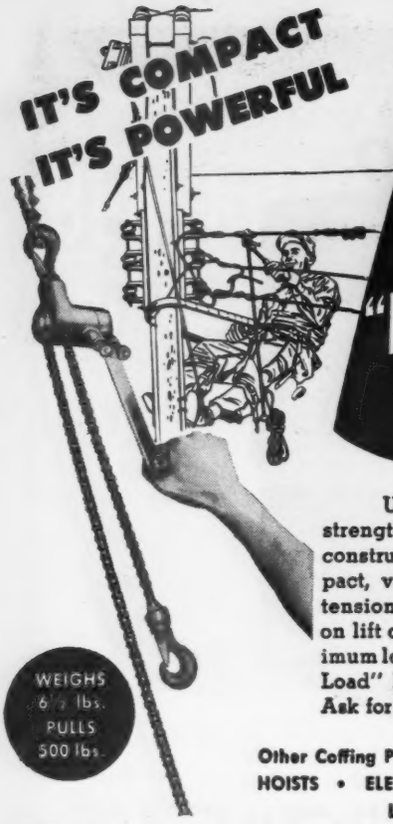
The Dongan Line Since Nineteen-Nine

DONGAN TRANSFORMERS



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IT'S POWERFUL

It's the NEW COFFING "MIGHTY-MIDGET" PULLER

WEIGHS 6½ lbs.
PULLS 500 lbs.

Use the *new* "Midget" Puller to save time and strength on scores of jobs in utility and electrical construction and maintenance. One of the most compact, versatile tools ever made for tightening wire, tensioning guys, lifting equipment. 500 lb. capacity on lift or pull, requiring only 28 lbs. of effort at maximum load. Snaps on lineman's belt. Two-way "Safety-Load" handle serves as lever or high speed crank. Ask for Bulletin EMP-2.

Other Coffing Products: The HOIST-JACK • SAFETY-PULL HOISTS • ELECTRIC HOISTS • SPUR-GEARED HOISTS • LOAD BINDERS • TROLLEYS

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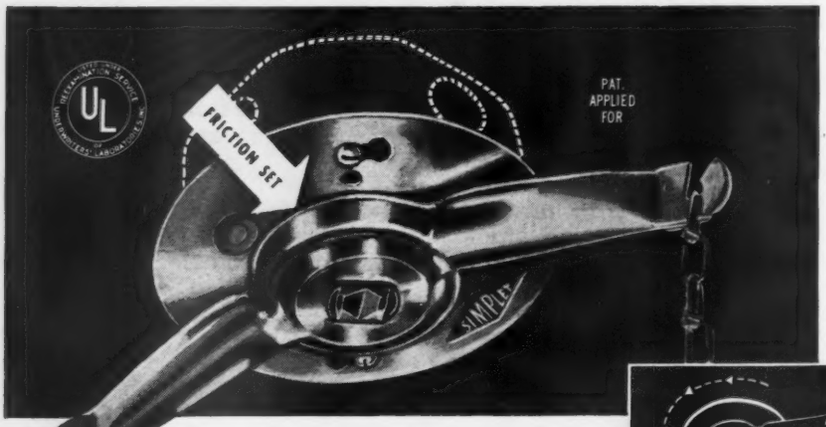
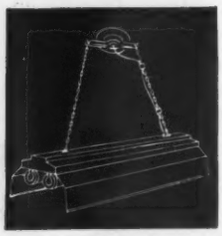


360° Adjustment



For any fixture position

NEW "Friction-Set" FIXTURE HANGER . . .
That Adjust With a Twist of the Wrist!

At last you can get a Fixture Hanger that turns to any angle after being screwed to an outlet box. Although base and receptacle remain stationary, hanger arms may be turned to align with any preconceived lighting plan. Exclusive Friction Ring firmly holds fixture in selected position. Hanger screws on to 3¼" or 4" outlet boxes, no other fastening necessary. Furnished complete with receptacle, two 5' chains, hooks and cord clips.

Friction-Set K100 . . . List Price $1.10
Write for Bulletin K25

SIMPLET ELECTRIC COMPANY
3600 West Potomac Avenue • Chicago 51, Ill.
112 Charlton Street • New York 14, N.Y.

New Equipment Briefs

Jefferson Electric Company, Bellwood, Ill. has introduced the "Wizard" universal mounting door bell **transformer.** It is designed for attachment to outlet box or cover, square or round; to wall of fuse or switch cabinet. . . . Shenley Electric Products Co., Chicago, Ill. has placed on the market a **fluorescent fixture,** known as the Illinois, with louver that can be hinged from either side. . . . . A new Batter-Up car **battery charger** which mounts permanently on the car is manufactured by Schuyler Engineering Service, Chicago. It can be plugged into any 115 volt a-c outlet.

A heavy-duty, service station **floodlight** with asymetric beam for uniform illumination over entire area has been announced by Westinghouse Electric Corp. It is designed for use with PS-52 bulb incandescent lamps from 750 to 1000 watts ratings or 400 watt mercury lamps. . . . . A **ventilating unit** made by Roto-Beam, Chicago, is claimed to be noiseless; non-corrosive, non-magnetic, free of vibration and distortion. Unit has standard 110 volt a-c motor. Also available for d-c, and in other voltages.

The Milwaukee Resistor Co. has announced production of a new ferrule type **resistor,** in which the ends of the resistor core are coated with copper, and serve as ferrules. . . . . Fast, complete fluxing of oily and uneven surfaces is claimed for a new non-acid **soldering flux** announced by Division Lead Company, Chicago. . . . . Harnischfeger Corporation in Milwaukee has introduced a new **magnetorque** control for overhead cranes. Unit consists of rotor and stationary field member through which braking forces are exerted electromagnetically.

The Foto-lator is a new type two-way **ventilator** for the darkroom, made by Trade-Wind Motorfans, Inc., Los Angeles, Calif. It can be installed in a wall, door or window opening. . . . A new packaged **amplidyne control unit** designed for use on steel mill and similar mill and processing line control applications where speed, current, or voltage regulation are required has been announced by General Electric Company, Schenectady, N. Y. . . . . A new line of sensitive multiple arm **relays** is being made by Signal Engineering & Mfg. Co., New York City. They are adaptable to a wide variety of circuit arrangements.

Talk-A-Phone Co., Chicago is introducing a two-station **inter-communication system,** known as "Elsie", for installation in homes, farms, professional offices, stores and other com-

mercial or private applications. It operates on a-c or d-c-110-115 volts. . . . . Natvar #400, **extruded vinyl tubing** is manufactured by the National Varnished Products Corp., Woodbridge, N. J. and approved by Underwriters' Laboratories for continuous operating temperatures at 105° C.

A new magnetic type **instrument** for liquid-level indications on transformers is made by Westinghouse Electric Corp. The weatherproof dial assembly eliminates fogging due to breathing and condensation under the glass. . . . . A new 200-watt R40 radiant Hi-flood **lamp** with medium base that fits fixtures for 150 watt PAR lamps is now being made by Radiant Lamp Corporation, Newark, N. J. Lamp is made of heat-resisting glass, and resists moisture, sleet, and vibration without cracking. . . . . The Coffing Hoist Company, Danville, Ill. has introduced a new "Mighty Midget" **puller** designed to pull or lift 500 lbs.

Wilson Welder and Metals Company, Inc., New York City has announced the "Hornet" motor generator arc **welding machine**, designed for either 220 or 440 volts with no change in relays or additional wires being required for voltage reconnection. . . . . A high speed supersensitive electronic registration **control** developed by the Ripley Company, Inc., Middletown, Conn. consists of a scanner and amplifier. . . . . A new line of electrical **wiring devices** designed for residential and commercial use are manufactured by the Plas-Tex Corporation of Los Angeles, Calif. Duplex receptacle is rated at 10 amps. 250 volts, 15 amps. 125 volts.

A new high visibility transformer temperature **indicator** has been developed by the Westinghouse Electric Corporation, Pittsburgh, Pa. . . . . A line of improved totally-enclosed, fan-cooled, wound-rotor **motors** has been announced by the Allis-Chalmers Mfg. Co., Milwaukee, Wis. Motors are built with an improved tube-type air-to-air heat exchanger. . . . . "CutTrode" is a new arc-vapor **cutting tool** developed by Eutectic Welding Alloys Corporation, New York City. It consists of a metallic core, surrounded by a sheath or coating which is resistant to heat at very high current ranges.

American Phenolic Corporation, Chicago, has developed three new industrial **tube sockets** for mounting industrial tubes on the face side of vertical control panels. . . . . The improved "Speed-Trol" variable speed electric power **drives** now provides fingertip speed control throughout, combining motor and speed control in one unit. . . . . A 25-kvar individual distribution **capacitor** with lower weight per kvar than existing 15-kvar units for reduced crossarm loading is made by Westinghouse Electric Corporation, Pittsburgh, Pa. . . . . Loopohm **resistors**, developed by Ward Leonard Electric Co., Mount Vernon, N. Y. are designed for continuous duty high current applications.

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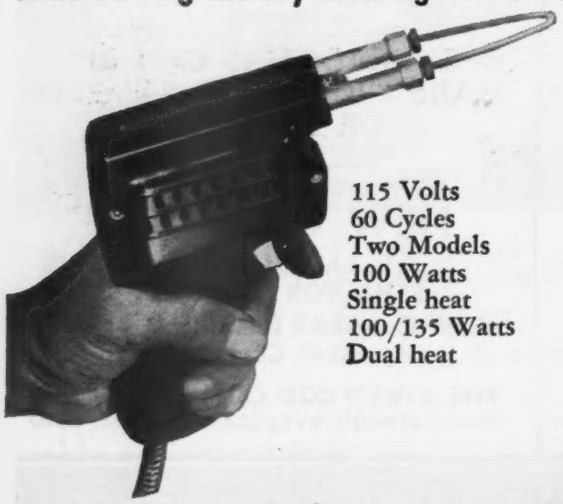
Time Saving-Money Making Features



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60 Cycles
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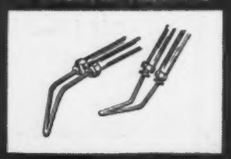
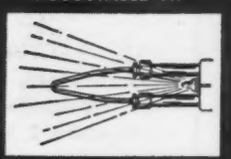

ADJUSTABLE TIP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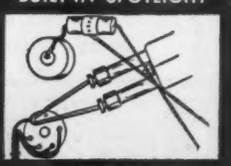
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DUAL HEAT

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WELLER Mfg. Co.

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Available with continuous current capacities from 20 to 110 amperes.

Horsepower ratings from ½ to 7½ are now available in the Roto-Cone variable pitch **pulley** made by Gerbing Manufacturing Corp., Chicago. . . . . The Den-El **safety clip** made by the General Scientific Equipment Co., Philadelphia, Pa., holds fluorescent tubes in place regardless of the amount of vibration. Two clips are required for each tube. . . . . Slimline commercial luminaire available for surface or suspension mounting, individual or continuous rows is made by the Keystone Electric Mfg. Co., Philadelphia, Pa. It can be equipped for 100, 200 or 300 milliamperes lamp operation.

The **Maasdam Pow'R** pull is for stretching wire, lashing poles to truck or trailer, loading or unloading heavy crates, cable reels. It is manufactured by Telephone Repair & Supply Company, Chicago, Ill. . . . . A new five ton capacity packaged **air conditioner**, designed especially for stores, restaurants and business houses is being produced by Frigidaire Division of General Motors. Refrigerating unit, motors, coils, fans are in a steel cabinet.

The "Flohr" **automatic radial guard** is for use on all portable horizontal tools, and is manufactured by Flohr Safety Equipment Inc., Buffalo, N. Y. . . . . Improvements in the 400 watt **mercury lamp** for street lighting and for general lighting where mercury lamps are desirable were announced by the Lamp Department of General Electric Company, Nela Park, Cleveland, Ohio. The inner arc tube of the lamp has been redesigned and the outer envelope of special heat-resistant glass is larger. . . . . A new portable **stock room case** with drawer kits holds complete line of fastening devices. It stands 15 inches high and is 10 inches wide. Case is made by Production Screw & Nut Co., Inc., Chicago, Ill.

Mitchell Manufacturing Company, Chicago has introduced a new **fluorescent industrial unit** which uses "Twin Turret" lampholder to eliminate broken sockets and falling lamps. It uses two 40 watt lamps. . . . . A new cord-saver **extension reel**, the Port-O-Reel, has been developed by Industrial Electrical Works, Omaha, Neb. It prevents kinks and simple knots by means of a cord-guide which level-winds the cord as it is rewound on the reel. . . . . The "Handy-Matic" is a motorized, completely equipped **portable repair shop** for "on-the-spot" repairs. Power is supplied by a 1/3 hp. motor, 110 or 220 volts, 60 cycle, a-c. This is manufactured by Wyzenbeek & Staff, Inc., Chicago, Ill.

This new redesigned improved complete line of hand **power cutters** features 15 improvements. They are made

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Don't take OUR word for it —write for facsimile copies of letters sent to us voluntarily by owners of the Oster "PIPE MASTER". Those letters are PROOF that this modern pipe and bolt threading machine is a real investment *because it's a steady profit-maker!*

Standard range of the No. 502 "PIPE MASTER" is 1/4" to 2" pipe. Extra range 1/8" pipe. Equipped with special drive shaft you can thread pipe up to 6". Bolt range is 1/4" to 1 1/2".

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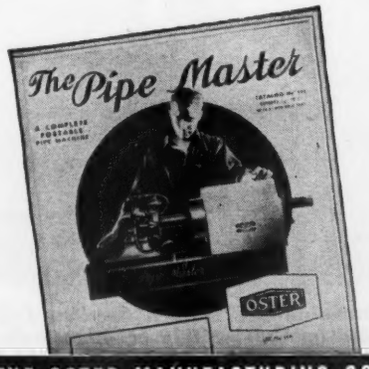

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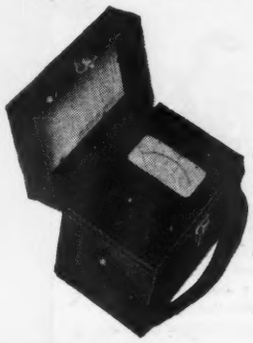

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Rugged, compact, portable instrument for convenient checking of AC and DC voltages. Three ranges, 0-150, 0-300, 0-600 volts. Both megohm and ohm ranges to cover entire range of resistance values encountered in construction testing. REQUIRES NO CRANKING. 36 models available.

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For measuring resistance of ground connections to earth

Portable, self-contained instrument for accurate, dependable testing of ground connections. Model 255 for extremely dry or moist ground conditions; Model 251 for average ground conditions. Merely push button for reading direct from dial. UNAFFECTED BY STRAY CURRENTS. Requires no cranking.

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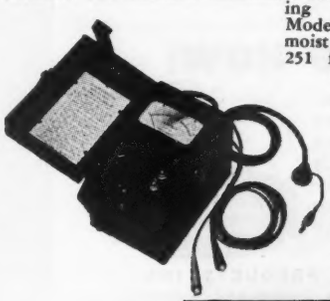

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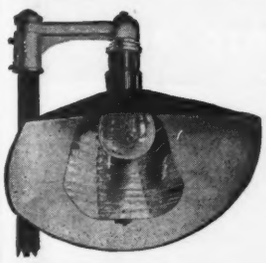

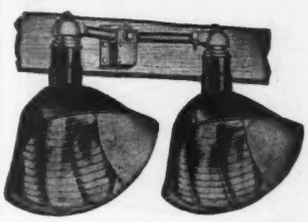

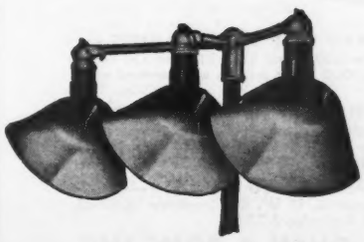

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● QUAD FLOODLIGHTS are made in various types so as to cover the field of sports lighting. These units all produce quantity and quality illumination. They place you in a position to cover the field in sales.

Among the features are individual light control and multiple mounting which provide flexibility. This makes them adaptable to any type of sports lighting.

QUADRANGLE MFG. CO.

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A well equipped, well manned laboratory has always been a "must" in maintaining and improving Superior quality.

29 Years OF LEARNING HOW!

The high standards of quality that produced the first Superior brush 29 years ago still prevail in the large brush shown at the right and others like it. Steady research at Superior has always underscored a *learn how* which we stress heavily as the one sure door to the *know how.*

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"Since 1919" SUPERIOR CARBON BRUSHES

New HEAVY-DUTY ELECTRIC PLANT

5000 WATTS Only 272 lbs!

MODEL 5CK-115M, 5000 WATTS D.C.

• Large capacity, compact design, and lightweight aluminum construction are combined in this new, rugged, portable electric plant. Easily carried by two men. Powered by Onan 10 HP horizontally-opposed, two-cylinder, 4-cycle, air-cooled engine. Unusual operating economy. Shipped complete, equipped with four-receptacle outlet box and mounted in tubular-steel guard frame.

NEW ONAN CK ELECTRIC PLANTS are available in 5,000 Watts D.C., 115 and 230 volts; 2000 and 3000 Watts A.C. in all standard voltages.

ONAN ELECTRIC PLANTS—*A.C.: 350 to 35,000 Watts in all standard voltages and frequencies. D.C.: 600 to 15,000 Watts, 115 and 230 Volts. Battery Chargers: 500 to 6,000 Watts, 6, 12, 32 and 115 Volts.*

ONAN AIR-COOLED ENGINES—*CK: 2-cylinder opposed, 10 HP. BH: 2-cylinder opposed, 5.5 HP. IB: 1-cylinder, 3.25 HP.*

Onan PRODUCTS

Write for Catalog

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2136 Royalston Ave., Minneapolis 5, Minn

ONAN ELECTRIC PLANTS

by H. K. Porter, Inc., Somerville, Mass. . . . . FEL-PRO 131 is the name of a new synthetic rubber material developed by the Felt Products Manufacturing Co of Chicago. . . . . Agnew Electric Company, Milford, Mich. has announced a new foot operated **spot welder** of the pivot type. It is furnished in 12, 18 and 24 inch throat depths with 10 kva. transformer.

United Condenser Corp., New York City has developed a line of plastic dielectric **capacitors.** They are available in a wide range of voltage and capacitance. Housings may be hermetically sealed metal cans, hermetically sealed glass or ceramic tubes, or wax-sealed cardboard tubes. . . . . The Hy-Kon Mfg. Co., Alliance, Ohio announces the **knockout trimmer** for enlarging holes in metal boxes. It also has a new **extension cord reel.** Pay out extension cord as needed and plug in. . . . . The new "Quikspotter" is a **fuse blow signal** and fits any fuse of common knife blade type. It is manufactured by Fuse Signal Products, Elmira, N. Y.

A new, large-diameter, narrow beam **floodlight** has been developed by Westinghouse Electric Corporation, Pittsburgh, Pa. It is designed for application at major-league ball parks, football stadiums, or other recreational field lighting where the floodlights must be mounted 100 feet or more from the area. Incandescent lamps up to 1500 watts can be used. . . . . Kolor-Therm Indicator Corp., New York City, has developed a **temperature indicator** called "Kolor-Therm". It is for use on electrical appliances, single phase motors, railway journal boxes, chemical apparatus, motors and other mechanical devices.

Attending the Eastern Section, IAEI, 23rd annual meeting at Atlantic City, N. J. were L. B. McConaghy and Henry M. Dreher, both of NEMA, and George W. Zink, electrical engineer for Phelps Dodge Copper Products Corp.

heavy duty CARBON LAMPS

for long life in severe service

Especially designed for industrial use.

In locations where vibration is excessive, where inaccessibility makes bulb replacement difficult and for pilot lights — Nalco Carbon lamps are a necessity.

Many standard types, shapes and sizes are available as well as standard colors and special shapes and colors. Standard screw and special bases are supplied according to your needs.

Order from your electrical wholesaler.

NALCO INFRA-RED BRITEMERS

NORTH AMERICAN *Electric Lamp Co.*

1044 Tyler St., St. Louis 6, Mo.

Simplex Pole Jacks

PULL OR STRAIGHTEN POLES... *Without Digging*

Compact and husky "H" beam sub-base provides a firm non-slip foundation, even on rough ground or in loose soil. Makes straightening poles, pulling butts or moving loaded poles a fast, easy job for one or two men. No. 329 handles poles of any size. No. 325, used for poles up to 30 ft. in height, includes 8' pike pole that's especially handy for straightening poles located beside ditches. Ask your distributor for full particulars, or write for Bulletin No. U46.

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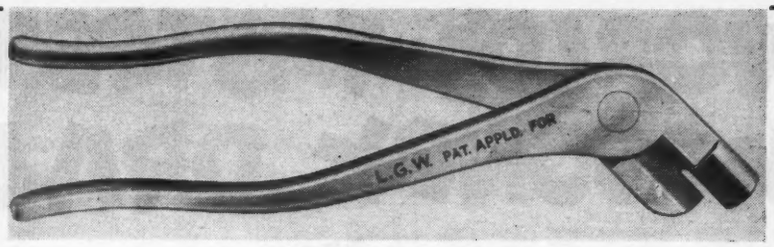

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Will tighten locknuts and bushings in switch boxes, utility boxes, panel boxes and junction boxes, assuring a permanent grounding system.

Will remove sharp edges and burrs from the inside or outside ends of conduit or steel tube.

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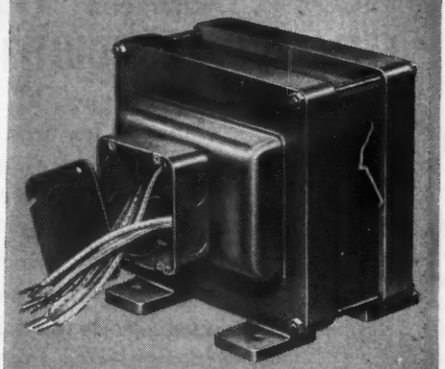

- Convenience In Wiring — Attached outlet boxes provide large, easily accessible wiring compartments for lead connections, take conduit or flexible cable from all 4 sides.
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- Dependability In Operation — Quality construction, with more-than-adequate insulation and vacuum impregnation of core and coil, assures long, service-free operating life.

Primaries
230/460 or 575 Volts
(50/60 Cycle)

Secondaries
115 or 115/230 Volts
½ to 10 KVA

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Division of Essex Wire Corporation
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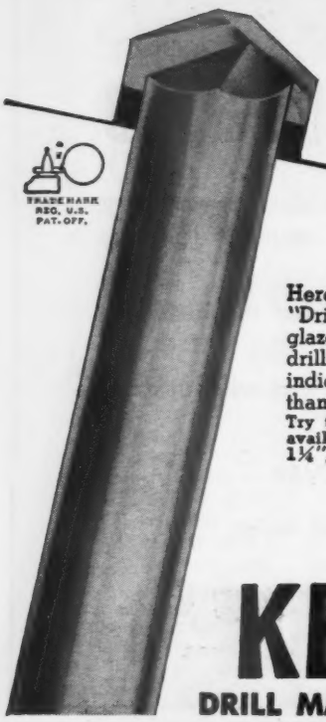

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Try them now—in any standard rotary electric drill. Sizes available: ¼", 5/16", 3/8", 7/16", ½", 9/16", 5/8", 3/4", 7/8", 1", 1⅛", 1¼", and 1½".

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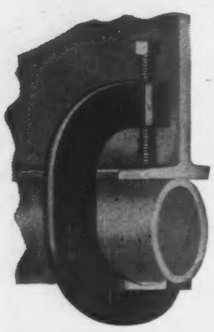
EFFICIENCY CONDUIT HANGER

The "Type F" Efficiency Hanger features five-point radiating ridges of gripping surface—holds conduit or cable at any angle on true mechanical principle—guaranteeing solid, non-slip support. Made of malleable iron in five sizes for supporting pipe from ½" to 2½", or armored cable.



Supporting pipe parallel to beam

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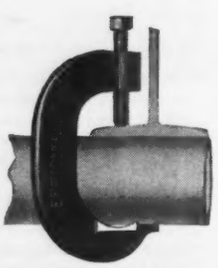

Supporting pipe at right angle to beam

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MANUFACTURERS OF EFFICIENCY ELECTRICAL DEVICES FOR CONDUIT, WIRE AND CABLE SUSPENSION

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ECONOMIC OUTLOOK

[FROM PAGE 77]

ing industries, however, will still have a long ways to go—oil companies plan to complete only a quarter of their postwar expansion program by the end of 1948.

2) *Business now plans to spend less on new plant and equipment this year than the record $16.1 billion spent last year. But the decline will not be great enough to bring on a business recession.*

At the time McGraw-Hill Research interviewed top executives, many companies had not approved their 1948 capital budgets. Under the extreme assumption that they will make no capital expenditures in 1948, industry's bill for new plant and equipment would run to $14.9 billion, or 8 percent below last year's record figure. Under the more realistic assumption that these companies will cut their capital investment only as much as companies that have already drawn up plans for 1948, industry's 1948 capital budget would run to almost $15.8 billion, a decline of less than $300 million from 1947. However, even a $1.2 billion decline is not enough to send business into a tailspin.

3) *Business executives must be convinced that a real slump is in the offing—and they are not convinced now—before they will slash capital budgets.*

Almost two-thirds of all manufacturing companies say they would not cut capital budgets sharply even if business activity declined 20 percent. What is more, a 15-20 percent boost in wage rates would have little effect on capital budgets—57 percent of manufacturing companies would not change their budgets; 26 percent would increase them; and 17 percent would cut.

4) *Manufacturing companies will finance most of their purchases of new plant and equipment from funds set aside out of past or current earnings. Utilities and railroads, on the other hand, must go to the securities markets or commercial banks to finance capital expenditures.*

5) *Most executives look for a smart increase in their company's sales.*

More than half of all manufacturing companies are planning on a sales increase over last year of 10 percent or more. A third of them say sales will be about the same as in 1947. Less than a tenth look for lower sales.

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TIME SWITCHES
of precision
• Synchronous
• Manually Wound
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For any load . . . for every installation, there is an Automatic Time Switch to meet the most rigid specification. Compact, ruggedly constructed *Automatic* Switches have pure silver contacts . . . tamper proof cabinets with visible dial . . . 2 to 24 "on" and "off" operations. For dependable automatic time switches specify *Automatic*.

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Sherman
ELECTRICAL FITTINGS

6) *Unless there is a complete about-face in business plans, business purchases of new plant and equipment will be slashed drastically in 1949.*

Most companies have laid no plans for 1949 but those that have expect to spend less than this year. More significant, however, is the fact that postwar expansion programs in manufacturing will virtually come to an end in 1949.

7) *Industry's production capacity in 1949 will be far above prewar.*

Manufacturing capacity will be more than 50 percent greater than in 1939 once postwar expansions are complete. Almost a third of all manufacturing companies report that their capacity will be double or more the prewar figure. Thus, 1949 may see a huge increase in production of many things that are hard to buy now.

8) *Capacity is uneven. Biggest increases are in the metal-using lines—Metalworking, Electrical Machinery, Automobiles.*

When postwar expansion is complete, these industries will have almost two-thirds more capacity than in 1939. But their suppliers, the metal-producing lines, of which the steel companies are by far the most important, will have only 40-50 percent more capacity. This is a big, a fundamental, shift in the structure of our productive plant. Before the war, metalworking output was geared very closely to steel output. The change suggests that metal-using industries may not be able to find uses for all of their new capacity or, if they do, that they will continue to have trouble getting enough metal to keep going full blast.

The focus of the McGraw-Hill survey of business plans for 1948 is on capital budgets which show how much business plans to spend for new plant and equipment. These expenditures, which are also termed capital investment or purchase of capital goods, have always played a leading role in business ups and downs.

Business capital expenditures have long been just about the most unstable factor in our economy. Between 1929 and 1933, for instance, the nation's total output dropped 46 percent while business purchases of new plant and equipment plunged from $9.2 billion in 1929 to $2.4 billion in 1933, a drop of 74 percent. The same pattern was repeated in the 1937-38 recession as it has been in almost every business downturn on record; total economic activity declined 5 percent from 1937 to 1938 whereas business purchases of

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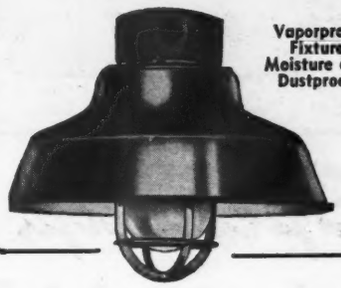
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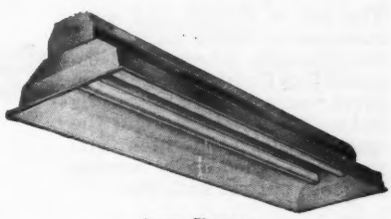
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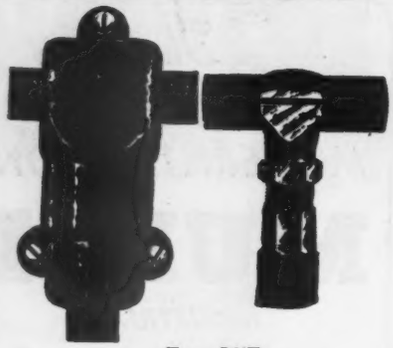


Type DHT

DOSSERT CONNECTORS

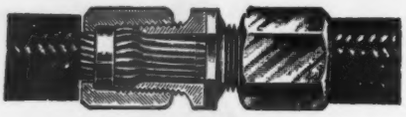
TYPE DHT

A hook type cable tap connector. The contact surface of the hook section and the compression gland are accurately machined to fit the conductor run, while the tap off section is available in the type "A" or type "B" construction illustrated below. This connector is available with an insulating cover for making compact insulated connections as illustrated.

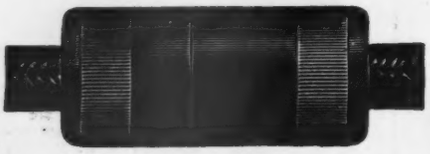
TYPE TW

A two way connector for coupling cables on end. Available in the type "A" or type "B" construction as illustrated. The type "B" construction develops many times the tensile strength of the conventional fitting. For instance with a 500MCM cable the tensile strength is 5,350 lbs. Both connectors are available with insulating covers type TWC to make an insulated joint as illustrated.

Two-Way Type "A" Construction



Two-Way Type "B" Construction



Two-Way Cover Type TWC

Send for literature on the type "B" construction which outlines comparative strengths and cable anchor applications.

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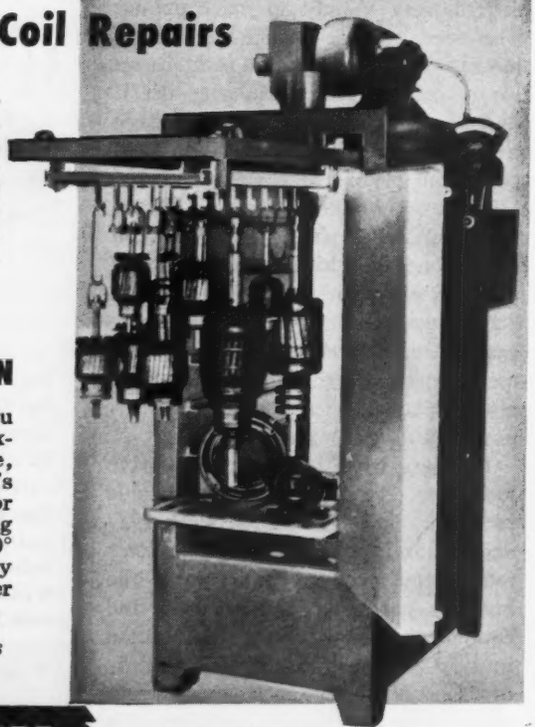

The job is RUSH and your customer is calling for his motor. There is where the Despatch R-S Finish Baking Oven gives you a big lift by *cutting baking time in half!*—and the quality will be top-notch. You can really speed up service and increase output with the

DESPATCH R-S FINISH BAKING OVEN

This oven has everything you need—positive air intake and exhaust, uniform temperature, quick pick-up after loading. It's easy to load and unload. Gas or oil fired, *very* economical, working temperatures from 200° to 500° F. Range of sizes, all shipped fully erected ready to use—no engineer required to set them up.

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capital goods dropped by 30 percent.

The reasons why business capital budgets are pared to the bone when business activity starts down are not hard to find. Capital goods are durable in that they wear out slowly. So businessmen can put off their replacement for several years. A second reason is that few companies are interested in expanding their capacity when they cannot use all their existing facilities. Then there is the fact that the money to finance capital investment is hard to come by when business is on the downgrade.

Economic theorists are still arguing the question of whether a cut in business capital budgets is the thing that sets off a recession or whether the cut in capital investment plans comes after the business outlook turns down for other reasons. But they would agree almost to a man that one of the best ways to gauge the business outlook is to find out how much business is earmarking for new plant and equipment.

Why Capital Budgets Are of Crucial Importance Now

In the next year or two business capital investment is certain to be more important than ever before in shaping the course of business activity. Business has been making up for the lack of capital investment in wartime and during the depressed 1930's. As a result, capital expenditures by private business have been running at a record $16.1 billion a year clip. That's more than double the totals in 1941 or 1929. So business capital expenditures swing a greater weight than ever before in the business outlook. And the question of how long the present boom in these expenditures will last becomes one of the key questions in any consideration of the business outlook.

A number of factors have added to the steam behind business' drive to revamp and expand its plant and equipment. Here are a few of the most important:

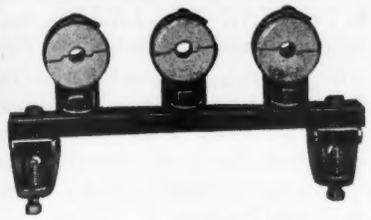
1) Business came out of the war with almost $70 billion of liquid assets, almost 3 times the prewar total. So for the first time since the 1920's business could afford new plant and equipment.

2) During the war, many, if not most, businessmen drew up postwar plans designed to expand their capacity for peacetime products by a big enough margin to keep going at their wartime pace.

3) Some industries, like petroleum and electric utilities, were in dire need of more capacity to catch up with the long term growth in demand for their products.

NEW!

Non-Inductive Conductor Racks



Racks available for any number of cables—cable sizes 5/16" to 2⅝".

● Available in types for any number of cable, the M & W Types S-L Conductor Rack is designed so that cables are only partially surrounded by metal. This prevents induced current—permits the rack to be used for A.C. or D.C. systems. Simple design makes for quick, easy mounting of cables.

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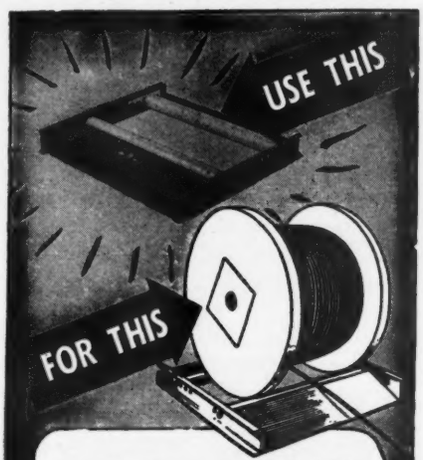

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4) The huge increase in labor costs during the war made the purchase of cost-cutting equipment a better bet than ever before.

The postwar business boom reinforced business demand for new capital goods. Earnings have been high enough to finance large purchases of new plant and equipment. Wage rates have already taken two big jumps. The desire to keep pace with competitors is another reason for the rush to buy capital goods. And, as always, a business boom gives business capital investment a powerful shot of optimism. The record level of business purchases of capital goods has, in turn, been one of the strongest props under the boom in general business. It has kept heavy goods plants running full-blast, thus accentuating material shortages. Moreover, it has added to inflationary pressures. The money spent on new plant and equipment is paid out in wages, salaries, dividends by companies making capital goods. So people have more money to spend but the supply of consumer goods will not be increased until the new plants and equipment get rolling. In some cases, like electric power or pipelines, this may take two or three years. In the meantime, the combination of more purchasing power with no more goods forces prices up—and that's inflation.

Because a large part of the postwar boom in business capital investment stems from wartime shortages, business purchases of new plant and equipment are almost certain to take a nosedive when such shortages have been made up and when postwar expansion programs are completed. This would remove at a single stroke one of the strongest props under the boom and one of the biggest sources of inflationary pressure. It goes almost without saying that the consequences for business in general would indeed be grave. A drastic cut in business capital investment could easily change the economic outlook overnight from booming prosperity to deflation and recession.

Most construction experts agree that the building boom will run on. There's still a big backlog of most types of construction. To cite only one case, new housing construction still hasn't caught up with the growth in the number of new families. So the dollar total of new construction may be up as much as 20 percent from last year's figure.

Business inventories are already about as high as they need to be to support the present level of activity. Thus, no big increase is in sight, though the dollar totals will move up if prices rise.

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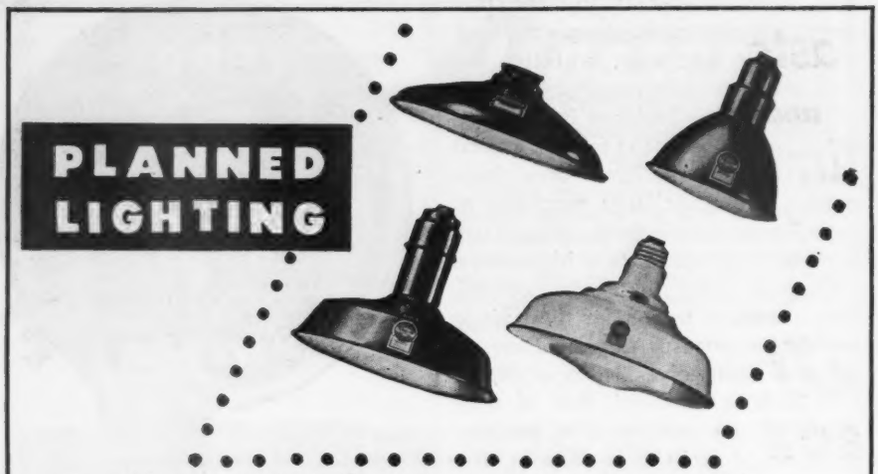

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INDUSTRIAL ELECTRONICS CORP.
80 Bank Street Newark, N. J.

FLOOD REPAIRS

[FROM PAGE 79]

steam or gas heat on the job. Usually these were kept at about 85 deg. C., and checked periodically with a megohmmeter, to determine the progress of drying out.

6. *TESTING FOR LEAKS*—An insulation resistance value of 500,000 ohms to 1 megohm was the usual range for dry stator windings. The minimum value for most motor and generator insulation, based on normal operating temperature, is expressed as: Megohms = Rated Voltage ÷ (Rated kva. + 1,000).

7. *RE-INSULATION*—Air drying varnish was most generally used for re-insulating the windings of low voltage equipment. Because the coil mass was already preheated from the drying operation, a good penetration was assured. Furthermore, the demand for oven space to accommodate other wet motors, and the clamor for delivery, made air-dry popular.

8. *SMALL TOOLS AND MOTORS*—Drills, grinders, polishers, and other industrial tools were completely disassembled and carefully cleaned. The armature and fields were baked at 210 to 275 deg. F., then reinsulated if found OK. All grease was removed from bearings, housings and gears, and re-packed with new lubricant. All fibre switch and brush riggings were replaced, and wire connections cleaned up and re-taped. Rust and dirt was removed from all parts, which were then coated with a film of thin oil.

COSTLY MISTAKES—Costly mistakes were made, after the flood, in operating partially dry equipment which caused the loss of good windings. Likewise, in the anxiety to get going, some equipment was severely overheated in crude ovens. Much equipment was sent to the motor shops for rewinding, which showed such evidence as blued shafts, charred insulation, and grounded coils. Customers admitted their error came from haste and a lack of regard for these damaging results of improper handling.

Flood repairs are usually handled under difficult, chaotic conditions. An orderly job handling procedure, however crude, and one or two of the more diplomatic and even tempered men to handle customer contacts can save valuable time and build tremendous good will.

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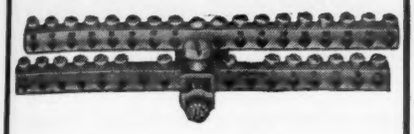

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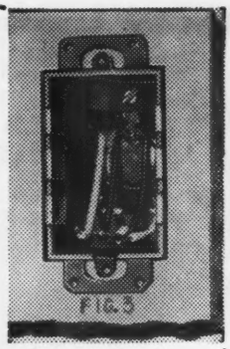

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The three-fingered Jiffy supports hold switch and outlet boxes securely in place without screws or nails. Fingers fold around edge of wallbox without need of tools. Cuts down on time needed for installing boxes, and does the job better. Order now.

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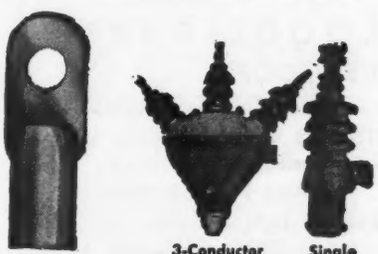

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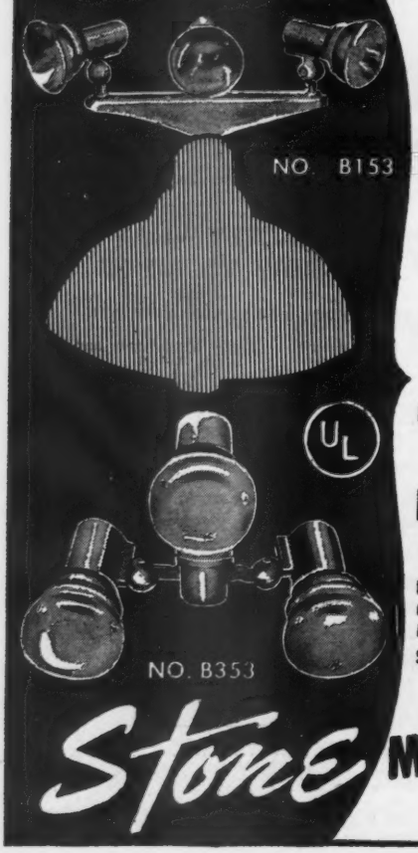

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PLANNED CHURCH LIGHTING

[FROM PAGE 88]

harmonious Byzantine motif to conform with the interior decorative treatment of the church. They also incorporate the lighting components specified by the consulting engineer to provide proper lighting for the area. Mounted on a spider in each lantern are three swivelier sockets, each containing a 100 watt neck-silvered Birdseye reflector lamp for projecting light upwards into the domed coffer. A 60 watt standard lamp is installed in the center of the lantern to light the glass panels softly. The leaf-design metalwork is wrought bronze. Special luminaires (Types A and B) were manufactured by Plainville Metal Products Company, Plainville, Conn.

The choir gallery at the rear of the nave is brightly lighted by 20 recessed 150 watt direct lighting units (Type D), set at intervals in plaster "furrows" built into the barrel arched ceiling. This construction was adopted so that the recessed units are completely shielded from the nave area, and so that all light is directed to the choir area to illuminate the music scores of the 100-voice male Russian choir.

The nave is lighted softly and uniformly from the indirectly lighted main dome, from recessed round lens direct lighting units installed in the soffits of the four arches between the four ornamental columns, and from the ten special design lanterns already described.

A plaster cove at the base of the rotunda of the main dome conceals 20 reflector lamps (Type E) of the 150 watt R-40 type. These lamps are mounted in swivel sockets to permit full adjustment, and wired alternately on three circuits so that each third lamp is on the same circuit. Light is directed from each reflector lamp to the opposite side of the rotunda, where murals will be painted later, and to the dome. Each lamp is adjusted so that the area is evenly lighted.

In each arched soffit are recessed five 300-watt round lens units, with the vertical segments of the Fresnel lenses coated opaque to cut down brightness and serve as a louver. These units provide high intensity illumination in the nave for reading, when required.

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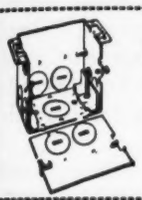

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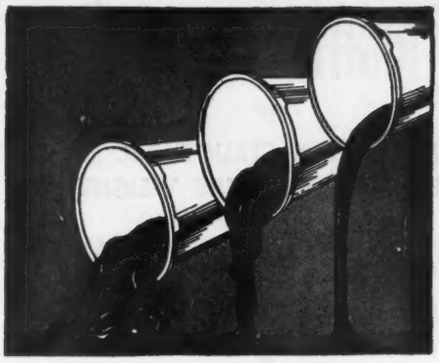

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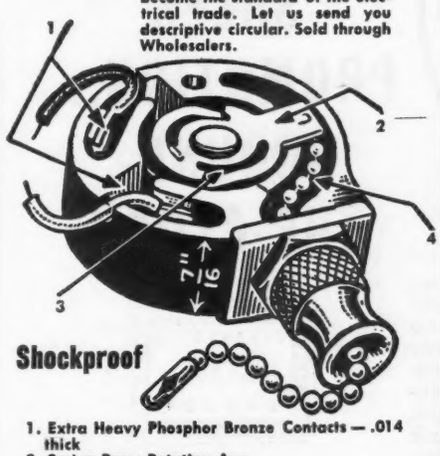

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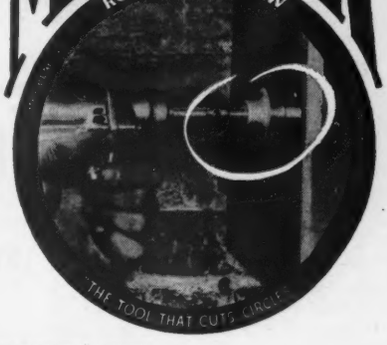

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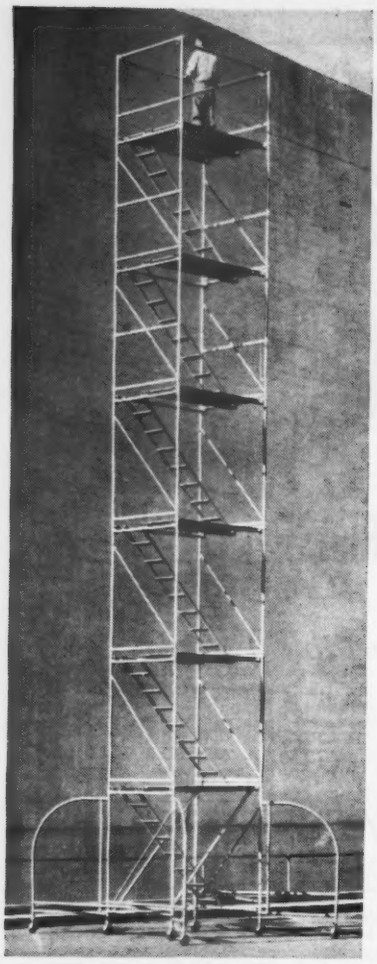

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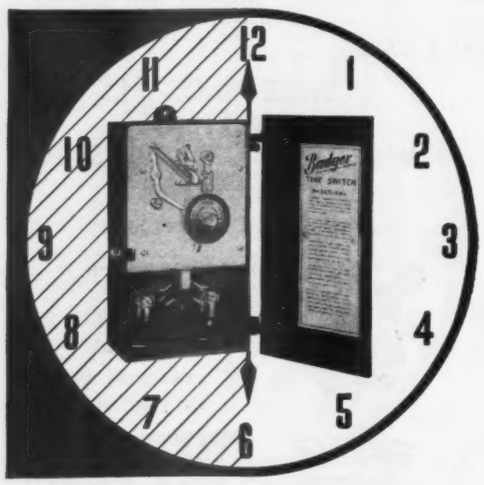

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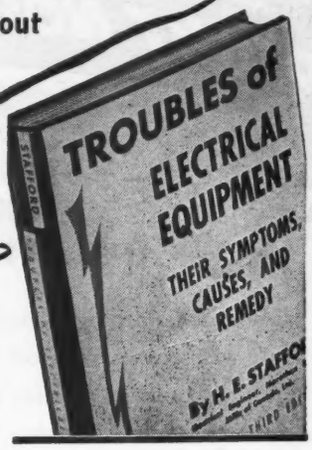

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